JAN 30 1926

The Engineer.

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VOL. CXLI.—No. 3653] LONDON: FRIDAY EVENING, JANUARY 1, 1926 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. WROUGHT IRON FIRE-BARS.
2. WHEELS and AXLES.
3. VERTICAL LOG BAND SAW, Motor-driven.
4. SLIDING, SURFACING and SCREW-CUTTING LATHES, 20in. and 24in. centres, Motor-driven.

Tenders due on the 12th January, 1926, for Nos. 1 and 2; on the 15th January, 1926, for No. 3; and on the 22nd January, 1926, for No. 4.
Tender forms obtainable from above. 1216

Assistant Engineer Required by the GOVERNMENT of ZANZIBAR for the PUBLIC WORKS DEPARTMENT for a tour of 20-30 months' service. Salary £460, rising to £500 a year by annual increments of £20, and thence to £600 a year by annual increments of £25. Free quarters and passages and liberal leave on full salary. Outfit allowance of £30 on first appointment. Candidates, age 25-35, must have passed the examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications.—Apply at once by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/14,164. 1191

Civil Engineer Required by the GOVERNMENT of CEYLON for appointment as Irrigation Engineer for three years in the first instance, with possible permanency. Salary £500, rising to £900 a year by annual increments of £40 (£600 on attaining 30 years of age). Free passages provided. Candidates, unmarried, age 26-31, must have passed the examination to qualify for Associate Membership of the Institution of Civil Engineers or hold equivalent professional qualifications, and have had at least three years' practical experience on waterworks, drainage or harbour and dock works.—Apply at once by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/14,038. 1192

Civil Engineer Required by the GOVERNMENT of TRINIDAD for the PUBLIC WORKS DEPARTMENT for three years' service, with possible permanency. Salary £400, rising to £450 by annual increments of £25. Free first-class passages. Candidates, preferably single, age 25 to 30, must have passed the examination to qualify for the A.M.I.C.E. or hold equivalent professional qualifications, and have had at least five years' practical experience on Civil Engineering Works of some magnitude, including waterworks construction and maintenance.—Apply at once by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,113 1190

The High Commissioner for India REQUIRES an ASSISTANT ENGINEER INSPECTOR (MECHANICAL) for service in England. The post is on a non-pensionable basis, and will be held in the first instance on probation for two years, during which period the services of the incumbent may be dispensed with at one month's notice. Thereafter service will be terminable by six months' notice on either side.
Salary £150, rising by annual increments to £300. Prospect of £310, rising by annual increments to £400, by promotion to Inspector. These salaries carry a variable cost-of-living bonus on the Civil Service scale. At present the bonus on £150 amounts to £88.
Candidates should be 28 to 35 years of age, have good technical and shop training and have held some position of responsibility. All-round rather than specialised experience is desirable. Preference given to A.M.I. Mech. E. or equivalent. Previous inspection experience not essential.
Applications, stating age, training and experience, and enclosing copies of recent testimonials, to be sent to the DIRECTOR-GENERAL, India Store Department, Belvedere-road, Lambeth, S.E. 1, not later than 15th January, 1926. 1190

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 464

University of the Witwatersrand, Johannesburg.
DE BEERS' PROFESSOR OF MECHANICAL ENGINEERING.
APPLICATIONS are INVITED for the DE BEERS' CHAIR OF MECHANICAL ENGINEERING at the above University.
The holder of the Chair is assisted by several Lecturers, and the workshops will be under his charge. New Laboratories for the Department are now in process of being built and equipped.
The salary will be at the rate of £1000 per annum, rising to £1100 by two annual increments of £50. An amount of £100 will be allowed for passage expenses to South Africa. In addition, a free first-class ticket is provided from Cape Town to Johannesburg, and half salary is paid during the voyage.
Participation in the University Teachers' Provident Scheme is compulsory.
The appointment, which is a full-time one, is subject to all the conditions and rules now in force, and duty is to be assumed as early as possible.
Further particulars as to conditions of service may be obtained from the SECRETARY, Office of the High Commissioner of South Africa, Trafalgar-square, London, W.C. 2, from whom forms of applications may also be obtained.
Applications (7 copies of each) accompanied by testimonials, should reach the High Commissioner of South Africa not later than the 1st February, 1926. 1137

TO LIFT USERS.
Tenders are Invited for the PURCHASE of a SECOND-HAND ELECTRIC PASSENGER LIFT, in very good order.—Full particulars from HENRY LEA and SON, Consulting Engineers, 151-3, Edmund-street, Birmingham. 1210

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

PROGRESS OF THE

ENGINEERING, SHIPBUILDING,

AERONAUTICAL

and

TRANSPORT INDUSTRIES

in 1925.

PUBLIC NOTICES

Bethnal Green Board of Guardians.
INSTALLATION OF BOILERS.
The Bethnal Green Board of Guardians invite TENDERS for the SUPPLY and INSTALLATION of THREE LANCASHIRE BOILERS at their Hospital, Cambridge-road, Bethnal Green, E. 2.
A copy of the specification and of the plan can be inspected at the under-mentioned address any weekday between 10 a.m. and 1 p.m. and 2 p.m. and 4 p.m., Saturdays excepted. A form of Tender and specification will be supplied upon deposit of £5, which will be returned upon receipt of a bona fide Tender.
Sealed Tenders, endorsed "Lancashire Boilers," must be delivered at my Offices, as under-mentioned, not later than 12 Noon on the 19th January, 1926.
The Guardians do not bind themselves to accept the lowest or any Tender.
C. FAULKNER JONES,
Clerk to the Guardians.
Administrative Offices,
Bishop's-road,
Bethnal Green, E. 2.
18th December, 1925. 1142

County of London.
SUPPLY OF TRAMWAY RAILS, 1926-27.
The London County Council invites TENDERS for the SUPPLY and DELIVERY in London of (a) about 4425 TONS of STANDARD STEEL GIRDER TRAMWAY TRACK RAILS, FISH-PLATES and FISH-BOLTS, &c.; (b) about 600 TONS of CONDUCTOR RAILS, the supply and delivery of which will form the subject of a separate contract.
Persons desiring to Tender may obtain drawings, specifications, bills of quantities, forms of Tender, and other particulars on application to the Chief Engineer of the Council, Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2 in each case. This amount will be returnable only if a bona fide Tender is submitted and not withdrawn. Particulars may be obtained on application at the Old County Hall before payment of the fee.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and in the "London County Council Gazette."
Tenders are to be delivered to the Clerk of the Council at The County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 25th January, 1926.
No Tender received after that time will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
1186 Clerk of the London County Council.

Great Southern Railways.
The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of the following MATERIAL :—
2400 TONS No. 90 R. BULL-HEAD RAILS (British Standard Section).
70 TONS FISH-PLATES for Ditto.
1600 TONS CAST IRON CHAIRS.
4600 TONS 85 lb. FLAT-FOOT RAILS.
120 TONS FISH-PLATES for Ditto.
1150 TONS CAST IRON SOLE PLATES.
Specifications, forms of Tender (on which alone offers will be considered) and drawings can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of Two Shillings and Sixpence for each Tender form.
Tenders should be forwarded so as to reach the undersigned not later than 10 a.m. on Thursday, 21st January, 1926, in the envelope provided for the purpose.
The Directors do not bind themselves to accept the lowest or any Tender.
C. E. RILEY,
Secretary.
Kingsbridge Terminus, Dublin,
December, 1925. 1207

PUBLIC NOTICES

City of Wakefield Waterworks.
RYBURN SCHEME.
CONTRACTS FOR CAST IRON PIPES.
The Corporation invite TENDERS for the SUPPLY of the following CAST IRON PIPES and SPECIAL CASTINGS :—
CONTRACT No. 2.—4600 TONS 22in. PIPES.
CONTRACT No. 3.—6200 TONS 20in. PIPES.
Specifications, conditions of contract, forms of Tender, and other particulars can be obtained from Mr. C. Clemesha Smith, M. Inst. C.E., Waterworks Engineer, Town Hall, Wakefield, on and after Monday, January 4th, 1926, on payment of a deposit of Two Guineas in respect of each contract, which will be returned on receipt of bona fide Tenders and the documents supplied.
The Corporation do not bind themselves to accept the lowest or any Tender.
Tenders, endorsed "Cast Iron Pipes," to be delivered to me not later than Twelve Noon on Monday, January 18th, 1926.
A. C. ALLIBONE,
Town Clerk.
Town Hall, Wakefield.
22nd December, 1925. 1160

Liverpool Corporation Waterworks.
PUMPING MACHINERY.
DUDLOW-LANE, WAVERTREE, LIVERPOOL.
TENDERS are INVITED for the SUPPLY and ERECTION of PUMPING PLANT, consisting of a High-lift Electrically Driven Vertical-spindle Centrifugal Pump, at the Dudlow-lane Pumping Station.
Copies of the specification and form of Tender can be obtained from Mr. J. R. Davidson, Water Engineer, 55, Dale-street, Liverpool, upon payment of the sum of Two Guineas, which amount will be returned upon receipt of a bona fide Tender.
The Water Committee do not bind themselves to accept the lowest or any other Tender.
WALTER MOON,
Town Clerk.
Municipal Buildings, Liverpool,
29th December, 1925. 1209

PUBLIC HEALTH ACT, 1875.
Rural District of Headington, OXFORDSHIRE.
CONTRACTS NOS. 1 AND 2.
The Rural District Council of Headington, acting as the Sanitary Authority for the said district, are prepared to receive TENDERS for the MAIN DRAINAGE of HEADINGTON QUARRY (Contract 1) and LITTLEMORE (Contract 2).
Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Wednesday, the 6th of January, until Wednesday, the 20th of January, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of Three Guineas, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.
The successful tenderer will be required to execute a contract deed, the draft of which may be seen at the offices of the Consulting Engineers when the drawings are inspected.
Tenders must be on the official form, each Tender in a sealed envelope marked "Tender for Main Drainage." Tenders must be accompanied by the general conditions and specification as issued by the Consulting Engineers.
Each Tender must be signed in the handwriting of the tenderer or his authorised agent.
The Council does not bind itself to accept the lowest or any Tender.
Tenders must reach the undersigned by 9 a.m. on Wednesday, the 3rd of February, 1926.
Given under my hand the 22nd day of December, 1925.
LEONARD V. MURPHY,
Clerk to the Headington R.D.C.
Lloyd's Bank Chambers,
Carfax, Oxford. 1185

PUBLIC NOTICES

Richmond Union, Surrey.
STEAM BOILER AND HEATING INSTALLATION.
The Guardians invite TENDERS for the INSTALLATION of STEAM BOILER, CALORIFIERS, HEATING, HOT WATER SUPPLY, and other PLANT at the Grove-road Institution, Richmond.
Form of Tender, with specification, schedule of quantities and drawings may be obtained from the undersigned on payment of a deposit of £2 2s., returnable on receipt of a bona fide Tender. The specification, schedule of quantities and drawings may also be seen at the offices of the Consulting Engineer, Mr. T. J. R. Kiernan, B.Sc., M. Inst. C.E., 17, Victoria-street, Westminster, S.W. 1, between 10 a.m. and 5 p.m. on any weekday except Saturday.
Tenders to be delivered at the undermentioned offices not later than 10 a.m. on Thursday, the 28th January, 1926.
The Guardians do not bind themselves to accept the lowest or any Tender.
By Order,
CHARLES L. FENN
Clerk to the Guardians.
Guardians' Offices,
Parkshot, Richmond, Surrey,
23rd December, 1925. 1201

Sevenoaks Union, Kent.
POOR LAW INSTITUTION, SUNDRIDGE.
The Guardians of the Sevenoaks Union invite APPLICATIONS for the POST of ENGINEER-IN-CHARGE of the Plant at their Sundridge Institution, including Electric Light Installation, Steam Boilers, Gas and Steam Engines, Heating and Hot Water Supply Apparatus, Laundry Machinery, Cooking and Sterilising Plant.
Salary £3 5s. per week, with house and coal.
Applications, with copies of three recent testimonials, to be sent to the undersigned by 7th January, 1926.
By Order,
F. H. VIBERT,
Clerk to the Guardians.
Inglewood,
Oak Hill-road, Sevenoaks,
30th December, 1925. 1218

Singapore, Straits Settlements.
MUNICIPAL ENGINEER'S DEPARTMENT.
ASSISTANT ENGINEER.
ADVERTISEMENT.
The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER, age 24 to 30, unmarried, on a three years' agreement, with possible extension.
Candidates must have had a good general and technical education, and must have passed the examination for A.M. Inst. C.E. As the selected candidate will be required to assist generally in the Municipal Engineer's Department, a training or experience with a Borough Engineer is desirable, and preference will be given to those with experience in the design and construction of surface drainage works and sewers. Experience in irrigation work would be useful.
Salary 5400 dollars per annum for the first year, with annual increments of 300 dollars, the value of the dollar being fixed at 2s. 4d. The pay of the appointment for the first year at the above rate is equal to £630. If the candidate appointed should be retained in the service after the expiry of his agreement, he might rise to an annual salary of 9600 dollars, if found satisfactory. Free passage will be provided, with half-pay during the voyage out. A medical certificate as to fitness for service in the Tropics will be required from the selected candidate.
Applications, stating age, place of birth, and giving details of education, training and experience, referring to the above requirements in detail, and stating when free, accompanied by copies (only) of testimonials, and also personal references, must be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Commissioners (from whom further information may be obtained), not later than Tuesday, 5th January, 1926. 1115

Egyptian State Railways, Telegraphs and Telephones.

THE EGYPTIAN STATE RAILWAY ADVERTISER

A weekly publication in Arabic, English and French.

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For particulars apply to PUBLICITY SECTION, Egyptian State Railways, Cairo, (Egypt). 450

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SITUATIONS OPEN

WANTED, MANAGER for FOUNDRY in Scotland employing 250 hands; experience of Gas-holders, Oil Tanks and Electric Plant essential.—Address, with testimonials and stating experience and salary expected, 1204, The Engineer Office. 1204 A

WANTED, FIRST-CLASS CONTRACTOR'S BOOKKEEPER, Westminster; must have thorough knowledge up-to-date systems of keeping accounts and costing and general office routine.—State age, experience, salary required, with copies of recent testimonials, to Box 1780, c/o Brown's, 39, Tothill-street, S.W. 1. 1189 A

CENTRIFUGAL PUMP MANUFACTURERS have a VACANCY for DESIGNER, experienced in High-speed High-lift Pumps, suitable for direct coupling to Steam Turbines. Applications must state experience fully, with salary asked, and give references.—Address, 1220, The Engineer Office. 1220 A

CIVIL ENGINEER REQUIRED for Straits Settlements, on five years' agreement, A.M.I.C.E. preferred. Age about 30. Commencing salary about £52 per month. Passage paid.—Apply, giving full particulars of qualifications and whether married or single, to "Z. H. 824," c/o Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 1188 A

COST CLERK WANTED for Steel Tube Works, Birmingham; must have had sound training; some experience in similar trade an advantage. State age, salary and experience.—Address, 1217, The Engineer Office. 1217 A

ENGINEERS, with Good Experience in Gas and Oil Engines, Structural Steel Work, and Drawing-office, REQUIRED for Ceylon.—Apply, with full particulars, stating age, to KEMISH, 36, Basinghall-street, London, E.C. 2. P1340 A

ERECTING ENGINEER WANTED to Deal with Heavy Machinery and Conveying Plant. Educated men with good shop experience essential; chance of permanent job.—Address at once, stating age, experience, and salary required, 1214, The Engineer Office. 1214 A

HEATING ENGINEER.—Established London Firm REQUIRES SERVICES of thoroughly qualified HEATING ENGINEER, to Take Charge of Heating and Cooking Section. Applicants must be of good address, be thoroughly experienced in all branches, and must be personally known to architects and consulting engineers, and able to introduce business. To an energetic and reliable man a good position is offered.—Write, giving fullest information, salary required, in confidence, to P1350, The Engineer Office. P1350 A

TECHNICALLY EDUCATED ASSISTANT, with good knowledge of German and Chemistry, WANTED for Patent Agent's Office; salary £350 per annum.—Address, giving age and experience, 1232, The Engineer Office. 1232 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 98, St. George's-square, London, S.W. 1. 448 A

DRAUGHTSMEN REQUIRED, must have had Shop Training, be experienced in structural steelwork, colliery banking plant, and able to take out quantities from drawings.—State age, salary required, &c., to BUTTERLEY CO., Ltd., Butterley Ironworks, Derby. 1195 A

EXPERIENCED MECHANICAL DRAUGHTSMAN REQUIRED for London district.—Address, stating age, experience, and salary required, 1211, The Engineer Office. 1211 A

JIG and TOOL DRAUGHTSMAN REQUIRED by Large Firm of Motor Vehicle Builders in South of England. One having experience in Planning and Rate Fixing preferred.—Address, stating experience and salary required, 1205, The Engineer Office. 1205 A

JUNIOR DRAUGHTSMAN WANTED AT ONCE, with first-rate knowledge of Small Petrol and Paraffin Engines. State wages and experience.—Address, 1231, The Engineer Office. 1231 A

SENIOR DRAUGHTSMAN REQUIRED by important firm manufacturing Waterworks Pumping Machinery. This is a really good opening for a smart man with initiative and capable of taking charge of new design.—Address, stating age, salary required, and full particulars of experience, 1194, The Engineer Office. 1194 A

FOREMAN REQUIRED, West London District, to take charge of battery of automatics, consisting of Gridley, Potter and Johnson and Brown and Sharpe machines. Must have held a similar position and be used to turning out work to a high degree of accuracy.—Address, stating age, salary required, and details of experience in chronological order, to 1203, The Engineer Office. 1203 A

TOOL-ROOM and PLANT MAINTENANCE SHOP FOREMAN, with ability to Supervise and Push Work through to completion.—TAYLOR HOBSON, Leicester. P1359 A

PATTERN MAKERS, PERMANENCY for CAPABLE MEN. District rate.—Apply, P. J. SMITH, 24, Wynyatt-street, Goswell-road, E.C. 1. 1196 A

SITUATIONS WANTED

ELECTRICAL and MECHANICAL ENGINEER SEEKS RE-ENGAGEMENT; thoroughly practical, excellent refs., experienced in interviewing, advising, lay-out and supervision of contracts for industrial, private and country house plants and installations; complete factory equipment, &c.—Address, P1353, The Engineer Office. P1353 B

ENGINEER, Practical (32), DESIRES POSITION 14 years' exp., including Royal Navy. Experienced running and repairs, marine boilers, engines; turbines, hydraulic and compressed air plant, Diesel engines; knowledge of refrigeration plant, extensive machine and fitting shop experience, capable.—ADVERTISER, 70, Gauden-road, Clapham, S.W. 4. P1344 B

HYDRAULIC MACHINERY.—ENGINEER, with wide knowledge, DESIRES to REPRESENT first-class FIRM in London. Good connection. Intelligent representation guaranteed.—Address, P1348, The Engineer Office. P1348 B

MARINE ENGINEER (28 Years of Age), First-class B.O.T. Certificate (steam), DESIRES POSITION ashore, any position of trust accepted.—Address, P1341, The Engineer Office. P1341 B

YOUNG ENGINEER, Age 22, SEEKS PROGRESSIVE POSITION, home or Colonies; junior engineer, draughtsman, fitter and turner; 8 years' mechanical and technical training, workshops, theory. Qualifications, standard M.I.M.E., 2 years marine engineering, knowledge I.C., oil and reciprocating engines, turbines, boilers. — Address, P1356, The Engineer Office. P1356 B

YOUNG ENGINEER, Nine Years' Experience, works, D.O., &c.; apprenticeship, technical education, DESIRES SITUATION with prospects and scope for experience.—Address, P1339, The Engineer Office. P1339 B

YOUNG ENGINEER (24) DESIRES CHANGE, home or abroad. Ten years D.O. and works, served full articles, experienced oil and water boring, water filtration, softening and purification.—Address, P1337, The Engineer Office. P1337 B

SITUATIONS WANTED (continued)

EXPERIENCED MECHANICAL ENGINEER, accurate machining, gear-cutting, erecting, jigs, drawings, &c., capable and active, WORKS FOREMAN.—Address, P1355, The Engineer Office. P1355 B

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WELL-EDUCATED YOUTH (Age 17), Just Left School, WISHES to ENTER the OFFICE of a STRUCTURAL or CONSTRUCTIONAL ENGINEER. Small salary after probation.—D., 150, Effra-road, Wimbledon, S.W. 19. P1362 B

COMPETENT DRAUGHTSMAN, 11 Years' Experience with leading firms on steam power engineering, &c., comprising design, lay-out and details, DESIRES CHANGE; Manchester district preferred.—Address, P1364, The Engineer Office. P1364 B

DRAUGHTSMAN (22) SEEKS Progressive POSITION in London; 3 years machine shop and 4½ years D.O.—"G. W.," 175, Vauxhall Bridge-road, Westminster, S.W. 1. P1342 B

DRAUGHTSMAN, 24 Years of Age, Mathematical calculations, and also engineering for 10 years, I can draw to scale to suit requirements of any kind. Some permanent POSITION in London.—Address, P1345, The Engineer Office. P1345 B

ENGINEER DRAUGHTSMAN (26), Well Educated, with extensive erection experience of mechanical handling plants, SEEKS POSITION of RESPONSIBILITY as Engineer in Charge of erecting structural steelwork or Assistant to Works Manager. Would go abroad.—Address, P1363, The Engineer Office. P1363 B

ENGINEER and DRAUGHTSMAN DESIGNER (28) DESIRES POST demanding energy and initiative, technical or commercial. London district preferred.—Address, P1347, The Engineer Office. P1347 B

JUNIOR DRAUGHTSMAN (21) REQUIRES SITUATION; 7 years D.O. and shop experience in hydro-electric plants, pumps, gen. engineering, &c., good technical training.—GREEN, Nursery-road, Ringwood, Hants. P1346 B

YOUNG ENGINEER (Age 22), Disengaged, REQUIRES POSITION as Junior Draughtsman or Engineer; 6 years' practical training, 4 years' technical training; holds National Certificate in Mechanical Engineering.—Address, P1358, The Engineer Office. P1358 B

YOUNG MAN (23 Years), 6 Years' Workshop and D.O. experience, technical training, SEEKS POSITION as Junior Draughtsman. Nominal salary for experience.—Address, P1343, The Engineer Office. P1343 B

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EDUCATIONAL

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AGENCIES

ENGLISH REPRESENTATION REQUIRED.—SOCIETE ANONYME DES ANCIENS ATELIERS VAN DEN KERCHOVE, Ghent (Belgium), WISHES to APPOINT a REPRESENTATIVE in London (or in England) for the Sale of their Engines, Turbines, Motors and Machinery.—Reply as above, giving full credentials. P1280 D

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PATENTS

PATENT YOUR INVENTIONS, Trade Mark Your Goods. Advice, handbooks, and coils, free.—B. T. KING, C.I.M.E. (Regd. Patent Agent, G.B., U.S.A., and Canada), 146A, Queen Victoria-street, London, E.C. 4. 38 years' references. 444 H

PROPRIETOR of BRITISH PATENTS No. 7246/25 and 31,366, "Improvements in or relating to Appliances for Opening Receptacles, Tins and the like"—this appliance being a domestic safety-first, labour-saving tin opener—WOULD LIKE to MEET with PARTNER to MANUFACTURE SAME or WOULD SELL PATENT.—A. STURDEVENT, c.o. Messrs. Withers and Spooner, Patent Agents, 51 and 52, Chancery-lane, E.C. P1352 H

THE PROPRIETOR of BRITISH PATENT No. 1262/12, dated January 16th, 1912, relating to "Machine for Making Hairpins," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms, for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Ill. 1198 H

THE PROPRIETOR of BRITISH PATENTS Nos. 135,362 and 139,551, both dated January 10th, 1919, relating to "Improvements in Machine for Forming Hairpins or Similar Articles" and "Improvements in Machine for Counting and Arranging Hairpins or Like Forked Articles," respectively, is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms, for the purpose of exploiting the above patents and ensuring their practical working in Great Britain.—All inquiries to B. SINGER, Steger Building, Chicago, Ill. 1200 H

THE PROPRIETOR of BRITISH PATENT No. 107,559, dated March 30th, 1917, relating to "Improvements in Power Hacksaw-Machines," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or OTHERWISE on reasonable terms, for the purpose of exploiting the above patent and insuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois. 1193 H

THE PROPRIETORS of LETTERS PATENT No. 183,498, relating to "Improvements in Locomotives," DESIRE to DISPOSE of their PATENT or to grant LICENCES on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.—Enquiries to be addressed to CRUIKSHANK and FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery-lane, W.C. 2. 1197 H

THE OWNERS of BRITISH PATENT No. 193,627, relating to "Improvements in Sizing and Quenching Annular Metal Articles such as Cups and Cones for Roller Bearings," are DESIROUS of ENTERING into NEGOTIATIONS with one or more firms in Gt. Britain for the purpose of EXPLOITING the above invention, either by SALE of the PATENT RIGHTS or the GRANT of a LICENCE or LICENCES to manufacture on royalty.—Inquiries should be addressed to Messrs. ABEL and IMRAY, 30, Southampton Buildings, W.C. 2 1187 H

THE PROPRIETOR of LETTERS PATENTS No. 194,910, relating to "Improvements in or relating to Vacuum Cleaners," No. 196,752, relating to "Improvements in Vacuum Cleaners," and No. 197,085, relating to "Improvements in or relating to Portable Vacuum Cleaners," DESIRES to DISPOSE of the PATENTS or to GRANT LICENCES to interested parties at reasonable terms with a view to the adequate working of the patents in Great Britain.

Inquiries to be addressed to A. L. WENNER-GREN, Norrmalmstorg 2, Stockholm, Sweden, Director. 1221 H

THE PROPRIETORS of LETTERS PATENT No. 176,304, relating to "Improvements in or relating to Fuel-injecting Apparatus for Internal Combustion Engines," No. 163,671, relating to "Improved Manufacture of Barrels and Casks," No. 163,672, relating to "Improved Manufacture of Barrels and Casks," No. 205,483, relating to "Improvements in Ignition Devices for Internal Combustion Engines," DESIRE to DISPOSE of the PATENTS or to GRANT LICENCES to interested parties at reasonable terms with a view to the adequate working of the patents in Great Britain.

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For continuation of For Sale Advertisements see page 94.

JANUARY 1, 1926.—VOL. CXLI.

THE ENGINEER.

A Seven-Day Journal

Imperial Airways.

THE report of the directors submitted at the first ordinary general meeting of Imperial Airways, Ltd., held in London on Tuesday, showed that on the first year's working there had been a loss of £15,217, after providing £22,998 for reserve and £63,553 for depreciation and crediting the company with £139,410 received from the Government in subsidies. During the first month of the company's control no services were run as a result of a dispute with the pilots, and during the second only skeleton services could be operated. Much of the remaining portion of the year was an experimental period, in which the services were reorganised and modified. On the various services operated by the company over 825,000 miles were flown during the year—the subsidy agreement stipulated a minimum of 800,000—and 11,000 passengers and 600 tons of goods and mails were carried. Speaking at Tuesday's meeting, the chairman of the company, Sir Eric Geddes, intimated that the agreement with the Air Ministry regarding the proposed Egypt-India service had been completed and that it was confidently hoped that the first machine would traverse the route not later than January 1st, 1927. The service is to be conducted by means of triple-engined aeroplanes flying between Cairo and Karachi, a distance of about 2500 miles. The agreement provides for the payment of an annual subsidy of £93,600 for five years and the provision by the Government of aerodromes, hangars, and other accommodation. The board of the company, Sir Eric stated, believed that the service could be run profitably, on the terms indicated, as part of the company's organisation as a whole. Imperial Airways at present operates a regular service to Basle and Zurich, and, looking to the future, Sir Eric expressed the hope that it would be possible to institute a fast connection mainly by air between Basle and Cairo and eventually to extend the service at the other end by reaching out from Karachi to Bombay and Calcutta. In still more distant days, he remarked, the company's machines might fly regularly to Rangoon, Singapore, and even beyond.

The French Balance of Trade.

THE development of the French export trade during the past year is regarded as palpable evidence of the country's economic prosperity. The margin between exports and imports has been steadily widening, and the difference constitutes a "balance of trade" which the French look upon as an addition to their material wealth. Money is coming into the country by the restriction of foreign purchases and the selling of more goods abroad. The assurance that the "balance of trade" is a proof of prosperity has, however, been somewhat shaken by the recent statement of Mr. Walter Leaf, President of the International Chamber of Commerce, who affirmed that the surplus of exports was due to the diminution of imports, particularly of raw material, and that consequently the expansion of exports meant that the country was living upon its stocks, which tended towards exhaustion. The theory is admitted by the French, with certain reservations, one being that the diminution of imports is due mainly to the heavy contraction in the purchases of foreign coal. The considerable development of the colliery industry in the Nord, and the temporary annexation of the Saar coal basin, have enabled the French to dispense with a corresponding quantity of foreign coal, so that a diminution of fuel imports is a distinct gain to the country. Deducting coal, the decline of raw material imports during the year is only about 8 per cent. The expanding export of raw material is, of course, a serious factor, and although it is due partly to the consignments abroad of non-ferrous metals from North Africa and elsewhere, which the higher prices now ruling permit of being mined profitably, it is certain that stocks of scrap iron and other raw material are becoming depleted. The Government has already taken measures to limit the exportation of scrap iron and to prohibit the sending abroad of non-ferrous metal scrap. It is now suggested that an inquiry should be made into the desirability of constantly maintaining stocks of raw material, so that the country may be prepared for any emergency.

Electricity Supply Schemes.

THE Metropolitan Electric Supply Company has deposited a Bill for the next session of Parliament with a view to extending its area of supply in Berkshire, Buckinghamshire, Oxford and Surrey. Among the boroughs which the company seeks to serve are Reading, Wokingham, Henley-upon-Thames, Basingstoke, Godalming, Guildford, Kingston-upon-Thames, Reigate, Richmond, Wimbledon, and a large number of urban and rural districts, including Alton, Farnborough, Fleet, Dorking, Epsom, Farnham and Leatherhead. Within the existing area and the proposed extended area, the company seeks statutory rights to exercise the powers of a power company, in addition to those of an electric supply company. The London Power Company, which, before the passing of the London Electricity Act, 1925, was known as the London Electricity Joint Committee, 1920, is promoting a Bill in Parliament next session to acquire nearly forty-five acres of land in Heston and Isleworth. The land is required to meet the increasing demand for supplies of electricity, which the company is under obligation to afford, and in order to cope with that demand it is necessary to erect a generating station or stations on the land it is proposed to acquire. The generating station plans are to be submitted to the Electricity Commissioners and the Port of London Authority, and the company seeks to be empowered to carry into effect agreements for the abstraction of water from the river Thames for condensing purposes.

An Interesting Ship Repair.

THE British steamship City of Singapore, which arrived in England a little over a week ago to take up again, early in January, her service with the Ellerman Lines, Ltd. (Hall Line, Ltd.), rejoins her fleet after an eventful interval of about a year and eight months. In April, 1924, the vessel was seriously damaged, and her engines practically destroyed by an explosion and fire in the engine-room which took place at Adelaide. For some months it appeared doubtful if the vessel could be saved, but eventually she was salved and temporarily repaired by Mr. W. J. Russell. A little more than a year after her accident, she left Adelaide on April 11th in charge of the Dutch tugs Willem Barendszn and Vlaanderen, and after a journey of over 13,000 miles she reached Rotterdam on September 1st, 1925. Although the ship arrived two months later than was expected, repair work on her was at once begun by the Rotterdam Dry Dock Company, Ltd., and she was completed and delivered to her owners two weeks before the contract date. It was necessary practically to cut the ship into two parts, in order to carry out the extensive repairs which were required. The operations of salving, towing and reconditioning the City of Singapore were carried out with an ingenuity and dispatch which reflects credit upon all who were concerned with the work. It would be interesting to learn how the cost of the work done compares with that which would have been incurred if the repair had been carried out in Australia.

Synthetic Materials.

IN the course of an address delivered in Melbourne, an account of which has just reached this country, Sir Frank Heath, secretary to the British Department of Scientific and Industrial Research, emphasised the growing importance of synthesis, as compared with unaided natural processes, in the production of useful commodities. Engineers are, of course, quite familiar with such operations as the synthetic combination of hydrogen and nitrogen, to form ammonia, while the manufacture of "artificial silk" is now commonplace. Both these industries have been built up without apparently damaging older vested interests. The latest reports from France and China, for instance, concerning the silk trade show that it is experiencing an unusual prosperity. Sir Frank, however, warned the Australians that they were now in peril of competition from an artificially produced wool, and said that it would be necessary to improve the lower grades of natural wool to meet this competition. Presumably he referred to the recently patented process of treating cotton so as to produce a woolly effect on the fibres. This material is admittedly not equal to natural wool of good quality, but it promises to take its place in the case of lower grades. In any case, the new process should provide a source of impetus to industry. From the engineer's point of view, however, Sir Frank's remarks concerning paint are, perhaps, of greater interest. He said that he had noticed on board the exhibition train of the Commonwealth some native made pianos that were finished with a varnish made in the United States, the foundation of which was butyl-alcohol. This material was being manufactured synthetically in Germany by a highly elaborate process, but was derived from molasses in America. In either case it was in competition with the natural gum varnishes of Australia. It is noteworthy that although Sir Frank was convinced, so he said, that within a few years the existing paint industries of Australia and Britain would be swept away by paints and varnishes made from butyl-alcohol, he did not, according to all reports, make any reference to the coverings with a cellulose base which have been so successfully developed in this country recently. They again are of a more or less synthetic character.

The Royal Mint.

THE annual report of the Deputy Master of the Royal Mint is of interest as showing the extent to which the Department undertakes work for foreign countries which might quite well be executed by private firms in, say, the Birmingham area. It is shown that during the year 1924 the number of coins struck reached a total of over 223 million, and had a sterling value of nearly 8¼ million pounds. Of these coins 8½ million, or more than one-third of the total output, and representing one-third of the total sterling value, were struck on behalf of foreign countries. This section of the Mint's activities apparently included the execution of an order from the Soviet Government for 40 million silver half-rouble pieces, and for a large quantity of copper five-copeck pieces. During the year a contract was also entered into for the supply of coins to Poland, and negotiations were begun for the supply of coins to Latvia and for the entire silver coinage of Lithuania. New or reviving nationalities, the report notes, are now replacing their paper money with coins of a more durable material. Unless some deep considerations of high finance or international policy stand in the way, there is no reason why the minting of these coins should not be left to purely commercial enterprises.

The New Orient Liner Otranto.

THE new Orient Liner Otranto, which has been built by Vickers Ltd. at Barrow for the Australian mail service of the Orient Steam Navigation Company, Ltd., is now berthed at Tilbury Docks, preparing for her maiden voyage on January 9th. During the last weeks of the year she completed successful trials, and although designed for a service speed of 18 knots during her long run, a speed well over 19 knots was obtained. The Otranto is a sister ship to the Orama and the Oronsay, and her main dimensions are as follows:—Length, 658ft.; breadth, 75ft.; depth, 63ft., with a measurement of 20,000 gross tons. Her propelling machinery is of the twin-screw Parsons impulse and reaction turbine type, with single reduction gearing, and is designed for a total output of about 20,000 shaft horse-power, at a service speed of 18 knots. Unlike the Orama, in which superheated steam is employed, the turbines of the Otranto are supplied with saturated steam at a pressure of 215 lb. per square inch. The results of the recent trials of the Otranto would seem to indicate that a very satisfactory fuel consumption is likely to be obtained under service conditions. The new liner is the third 20,000-ton mail steamer which has been added to the Orient Fleet in a period of a little over twelve months.

Steam Locomotives of 1925.

ALTHOUGH 1925 was unfortunately a bad year for nearly all locomotive builders, and a very bad year for some, it was far from lacking interest, either at home or abroad. The three-cylinder simple engine, in which interest has been revived by Mr. Gresley's big products, excited a good deal of discussion, whilst Sir Henry Fowler's large order for three-cylinder compounds raised once more the never-ending arguments on the merits of multiple expansion. Feed-water heating, too, again came into notice with the introduction of a type which aims at overcoming the "deposit" difficulty by employing direct contact between exhaust steam and feed water. Locomotive engineers gave evidence that the question of coal economy is not being neglected, and certain engines showed a thermal efficiency which cannot be challenged by the electric locomotive. Furthermore, two firms at least in this country were engaged on the construction of turbine locomotives, and whilst no direct attack was made here upon the problem of the internal combustion locomotive, one company carried out interesting experiments in Canada which lead in that direction. In France the most notable event was the appearance of the eight-coupled passenger engine, while in America—see THE ENGINEER, October 9th—and in Germany experiments which may lead to the adoption of higher pressures were made.

London and North-Eastern Railway.

Mr. Gresley continued to exhibit that enterprise which we now expect from him, and to him must be given the honour of having produced the most notable British locomotive of the year, the Garratt engine for banking service between Wath and

FIG. 1—L. & N.E.R. ENGINE WITH LENTZ VALVE GEAR

Penistone. This great engine made its first public appearance in the centenary procession on the Stockton and Darlington Railway, and caused no little interest, as the type is unfamiliar in this country. It has been described already in these pages—see THE ENGINEER, June 26th—but it may be of service to recall here that it has two complete three-cylinder engines of the L.N.E.R. type, with Gresley valve gear driving 4ft. 8in. coupled wheels. The cylinders are 18½in. by 26in., and the working pressure 180 lb. The total weight is 178 tons and the starting tractive effort 77,220 lb. We understand that it is doing excellent work, and that it could handle greater loads than are available at present. It is of interest to note that Sir Henry Fowler has also decided to try the Garratt type, and has ordered two from Beyer, Peacock and Co., Ltd. They will not be so large as the L.N.E.R. engine.

Mr. Gresley also made further progress with normal engines by placing a three-cylinder "Mikado" type on the rails. This locomotive was described in THE ENGINEER of June 26th. Two other experiments which Mr. Gresley is making must be mentioned. Early in the year he fitted a Dabeg (Vickers Ltd.) combined feed-water heater and pump to engine No. 3500. This feed heater, of which a description was given in THE ENGINEER of July 3rd, is of the direct contact type, referred to above. The pump has two opposed cylinders fitted with plungers, which are actuated mechanically from a return crank on the trailing coupling-rod pin. The heater is placed above the pumps. One plunger draws the feed water from the tender and drives it into the heater, where it meets steam drawn from the exhaust; the other plunger propels the water into the boiler. The oil is removed from the exhaust steam by a nest of plates fitted in a container placed in front of the pump. We understand that this apparatus is proving quite satisfactory.

The other experiment to which we have alluded is the fitting of a Lentz valve gear to engine No. 8280, which left the Stratford works in 1922. This engine, which is illustrated by Fig. 1, has two inside cylinders which were originally fitted with Stephenson gear and rocking shaft. From the axle to the rocking shaft no change has been made, but additional levers, &c., have been added to operate the new gear. The Lentz valve-box is a separate casting studded on top of the cylinders, and contains four steam and four exhaust poppet valves, $6^{3}/_{16}$in. in diameter, which are actuated by cams and springs, the cams being moved by the Stephenson gear. The maximum valve opening for steam is 22.85 sq. in. and for exhaust 28.86 sq. in. So far the gear, which has been in operation for several months, has given very good results. We might mention in this connection that Wm. Beardmore and Co., Ltd., have taken up the manufacture of the Caprotti valve gear, which uses poppet valves operated by a revolving cam shaft, so that all the familiar motion is removed. As our readers know, both the Lentz and the Caprotti gear are largely used on the Continent.

Great Western Railway.

We hear from Mr. C. B. Collett that seventy-three engines, composed of the following types, were built at Swindon and put into service:—Ten 4–6–0, passenger, "Castle" type, four-cylinder; ten 2–6–0, goods, two-cylinder; forty-seven 0–6–2 T, goods, two-cylinder; six 2–8–0 T, goods, two-cylinder.

The engines of the 56 XX (0–6–2 T) class proved very successful in coping with the heavy traffic on sharp curves and gradients in South Wales. Fifty more of them are to be built at Swindon to replace a number of odd types taken over in the amalgamations. Twenty-three engines of the "Castle" class are now in service, including two "Stars" which were rebuilt as "Castles." One of the two-cylinder 4–6–0 "Saint" class—No. 2925—has been reconstructed, and put into service with 6ft. driving wheels instead of 6ft. 8½in., as shown in one of our Supplements to-day, and has proved satisfactory in dealing with traffic on the portions of the line where there are many heavy gradients.

The number of repairs carried out during the year was large, and 1060 engines, 753 boilers and 653 tenders were dealt with at Swindon. Moreover, many engines were repaired, and a great many new boilers supplied by outside firms, and the standardisation of the various types of engines taken over in the amalgamations was steadily proceeded with.

London, Midland and Scottish Railway.

During the year the London, Midland and Scottish Railway had in hand in its own works or in the works of makers the following engines:—One hundred 4–4–0 Midland type passenger compounds; twenty 4–6–0 Caledonian type passenger engines; five 4–4–2 Tilbury type passenger tank engines; and ten 0–4–4 Caledonian type passenger tank engines.

Of the hundred passenger compounds, thirty are being built at Derby, twenty at Horwich, twenty-five by the North British Locomotive Company, and twenty-five by the Vulcan Company. By the end of the year ninety-three of these engines were in service. The twenty 4–6–0 Caledonian engines are being built at St. Rollox, and five of them were completed. The ten 0–4–4 tank engines were all delivered in November by Nasmyth, Wilson and Co., Ltd., of Manchester. The same firm completed the five 4–4–2 Tilbury tank engines in August.

In addition to the foregoing, the works at Crewe, Derby and St. Rollox were busy completing an order for 180 0–6–0 freight tender engines carried over from 1924; Kerr, Stuart and Co., Ltd., and the North British Locomotive Company also assisted with the construction of these engines, and by the end of the year about one hundred and sixty were finished, leaving about twenty still to be completed at Crewe this year. The Hunslet Engine Company also delivered in the early months of the year eight 0–6–0 type goods tank engines, being the remainder of the order for fifty, delivery of which was begun last year and referred to in the Annual Review for 1924. At Crewe and Horwich work is well in hand for the building of one hundred 2–6–0 mixed traffic engines of a new design, but none of them were ready for service last year.

The hundred Midland type passenger compounds referred to above are numbered 1085 to 1184. They have three cylinders, one high-pressure 19in. diameter, and two low-pressure 21in. diameter; the coupled wheels are 6ft. 9in., the grate area is 28.4 square feet, and the tractive effort at 80 per cent. of 200 lb. on low-pressure cylinders, 22,649 lb. An outline diagram of this engine is given in Fig. 2, and a photograph of a similar engine is reproduced in Fig. 3. The 4–6–0 Caledonian engines are a repetition of the existing Caledonian 60 class, and will be numbered 14,630 to 14,649. The ten 0–4–4 tanks follow the standard Caledonian design, having cylinders 18½in. by 26in., and coupled wheels 5ft. 9in. diameter. The heating surface is:—In the tubes,

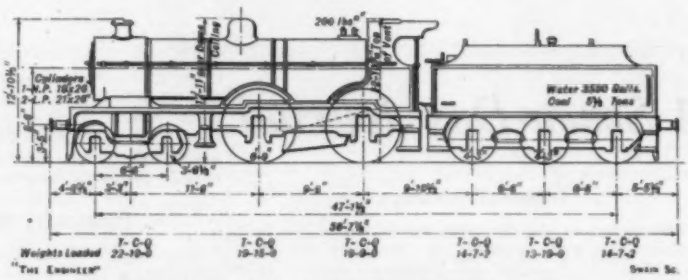


FIG. 2—L. M. & S. R. 3-CYLINDER COMPOUND ENGINE

975 square feet; fire-box, 110·9 square feet; total, 1085 square feet; grate area, 17 square feet. The working pressure is 180 lb. per square inch; the tanks carry 1270 gallons of water, and there is space for 2½ tons of coal. The engines weigh 57 tons 17 cwt. in working order. They bear the running numbers 15,260 to 15,269.

The five 4–4–2 tank engines are of the existing Tilbury design, and have cylinders 19in. diameter by 26in. stroke; the grate area is 19.8 square feet. The engines are numbered 2120 to 2124. They are identical with those referred to in last year's review.

Southern Railway.

In the past year considerable additions were made to the locomotive stock of the Southern Railway, more than eighty new engines having been added, including forty of the "King Arthur" class—see Supplement—of which thirty are distinguished by a new cab with extended roof and a larger tender holding 5000 gallons of water. Ten of these engines have been allocated to the Eastern Section for service on the Victoria-Dover Continental Boat trains, whilst thirty are used on the Western Section between Waterloo and Exeter, Bournemouth, and Portsmouth.

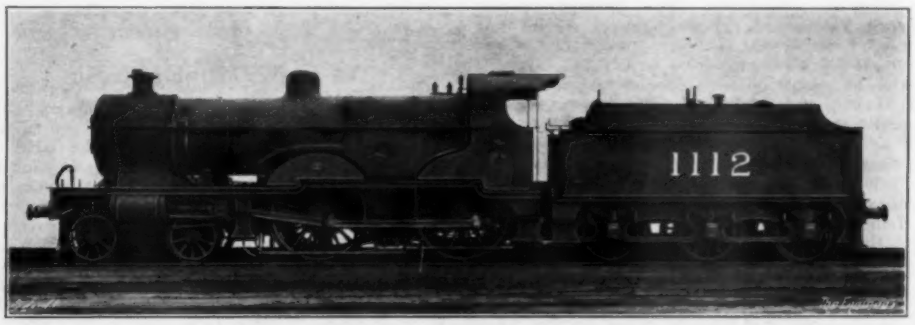


FIG. 3—L. M. & S. R. 3-CYLINDER COMPOUND PASSENGER ENGINE

Thirty more of the Woolwich-built 2–6–0 type engines were purchased from the Government for use on the Western Section. They are identical with Mr. Maunsell's "N" class engines, so that the company now possesses sixty-six of this useful mixed traffic type, of which one, No. 822, has three cylinders. One of a batch of ten new 2–6–4 tank engines, built at the company's Ashford Works, has also three cylinders, the cylinders, motion, boiler, &c., being interchangeable with those of engine No. 822. The remaining nine, with two cylinders, have been allocated to the Central Section for working Brighton and Eastbourne to Victoria trains. A new 2–6–2 narrow gauge tank locomotive was constructed for service on the Lynton and Barnstaple branch.

Makers' Locomotives.

The Avonside Engine Company did a good deal of work during the year, but mainly on standard lines, the only exceptional engine being a fireless locomotive for an Indian jute mill. The design follows more or less the conventional form for this kind of locomotive, as may be seen from Fig. 4, but may be regarded as on the large size, for it runs upon a 5ft. 6in. gauge and has cylinders 16in. by 18in. The initial pressure is 160 lb. and the working pressure 70 lb. It has small wheels, 3ft. 3in., and can therefore haul loads up to

400 tons, and it runs for about four hours without recharging. Charging takes place from a stationary boiler through a charging cock at the front of the steam drum through a Flex steel pipe fitted with spherical

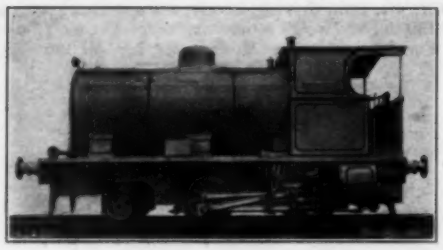


FIG. 4—FIRELESS LOCOMOTIVE—AVONSIDE

flanges and quick-acting connections. After the water in the drum has been heated up recharging takes only about ten minutes.

W. G. Bagnall, Ltd., turned out a good number of locomotives of various sizes for foreign purchasers, most of them to standard designs; but for the Madras and Southern Mahratta Railway six standard 4–8–0 goods engines were built during the year. This engine has been re-designed and brought up to date with circular smoke-box, piston valves, superheater, rocking grate, &c., and represents the latest type of Indian metre-gauge locomotives. A photograph of one of the engines is reproduced by Fig. 5. The cylinders are 17in. by 22in., the driving wheels 3ft. 7in. and the working pressure 160 lb. At 75 per cent. the tractive effort is 17,740 lb. In working order the engine and tender turn the scale at just upon 72 tons.

FIG. 5—MADRAS AND SOUTHERN MARRATTA RAILWAY, METRE GAUGE ENGINE—BAGNALL

Whilst Beyer, Peacock and Co., Ltd., of Gorton, Manchester, built during the year a number of normal locomotives, amongst which may be mentioned ten "Pacifics" for the Leopoldina metre-gauge railway of Brazil and some 2–8–0 engines for the Nizam's Guaranteed State Railways, the principal energies of the firm were directed upon the construction of Garratt locomotives. The six-cylindered engine of this type for the L.N.E.R., which put in its first public appearance at the Railway Centenary celebrations, will be remembered by all our readers. Another interesting engine is a 2–6–2, 2–6–2 express passenger locomotive with 4ft. 0in. coupled wheels, ordered as an experiment by the Union Railways of South Africa, the gauge of which is 3ft. 6in. It is now successfully handling the heaviest passenger trains at a speed of 55 miles per hour, the highest permitted. Some 2–6–2, 2–6–2's with 3ft. 9½in. coupled wheels were also completed for the same railways. The Argentine North-Eastern Railway is also trying Garratt engines, three of the 2–6–6–2, 4ft. 8½in. gauge, having been built for it by Beyer, Peacock and Co., Ltd. For the Bengal-Nagpur Railway two Garratt goods engines with the 2–8–8–0 wheel arrangement and weighing 180 tons each in working order were completed, and twelve engines of the 2–6–2, 2–6–2 type with 4ft. wheels were built for the Rhodesian Railways.

Another Garratt engine of particular interest is one constructed for the Indian State North-Western for trial purposes on the famous Bolau Pass Railway, which has a ruling gradient of 1 in 25. It has been delivered and is now undergoing its trials, but at the moment of writing reports are not to hand. The weight diagram—Fig. 7—shows the leading dimensions and a view of the complete engine is given in the half tone engraving—Fig. 6. Its total weight in working trim is something over 178 tons and the maximum axle load is 19½ tons. The cylinders, two pairs, are 18½in. by 26in., and they drive 4ft. 3in. wheels. Hence at 75 per cent. of the working boiler pressure of 180 lb. the tractive effort is 47,110 lb. The design as a whole is new, but with a view to facilitate repairs and renewals the details of standard engines of the Indian North-Western are employed. The dimensions of the boiler should be observed. It has an evaporative surface of 2469 square feet and a superheater surface of 550 square feet, with a grate area of 56·5 square feet. The gauge of the railway is 5ft. 6in.

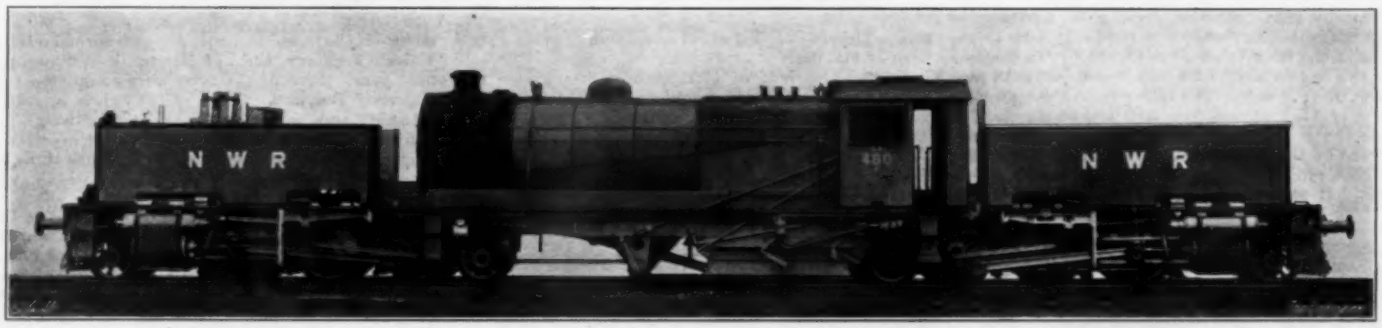


FIG. 6—INDIAN STATE NORTH-WESTERN RAILWAY, GARRATT ENGINE—BEYER, PEACOCK

Mention must also be made of the geared turbine locomotive which Beyer, Peacock and Co., Ltd., are constructing at their own costs for experimental purposes. In general characteristics it follows the familiar Ljungström design, but embodies British locomotive practice. A weight diagram is reproduced in Fig. 8, page 4. From it it will be seen that the total estimated weight is 143½ tons, of which 56½ tons are borne by the drivers. The turbine should develop 2000 horse-power, and at a boiler pressure of 285 lb. a tractive effort of 38,000 lb. is expected. The designed maximum speed is 75 miles per hour.

The drive from the main turbine to the driving wheels takes place through direct double helical gearing, having three reductions, the ratio of the gearing being 1 to 25.22. The main turbine is of the axial flow type, giving an output of 2000 horse-power, and has a speed of 10,000 revolutions per minute for an engine speed of 70 miles per hour, the driving wheels being 5ft. 3in. diameter. Such a speed will, of course, be easily attainable, as owing to the complete absence of reciprocating parts the engine can be perfectly balanced. This turbine is fixed to the condenser body and connected to the main gearing by means of flexible couplings. Reversing is effected by means of an idle shaft and gears operated from the drivers' footplate by hand or oil gearing.

The condenser is of the Ljungström air-cooled type, with auxiliary water surface condenser, the water being carried in the main condenser body and forming the supply for the boiler. The condenser elements are of copper tube, flattened and ribbed in accordance with the Ljungström method. The tubes number approximately 2500. The boiler is of the ordinary locomotive type, with Belpaire fire-box and inner fire-box of steel with steel stays. The tubes are of steel, 2¼in. outside diameter, and fitted with M. and L. superheater of the small tube type, giving a high degree of superheat. A working pressure of 285 lb. per square inch will be carried. The smoke-box contains an air preheater of the Ljungström design.

The engines of the greatest moment built by Kitson and Co., Ltd., Leeds, during 1925 were some 4–8–0 for the Pacific Railway of Colombia. These engines, designed by Mr. P. C. Dewhurst, incorporate features of British and American practice which fit them for tracks of light descriptions with spiked rails. The gauge is 3ft. and the rails weigh 55 lb. to the yard. Gradients are as great as 1 in 25 and there are some atrocious curves. The cylinders possess the curious feature that they are not "handed" and can be used on either side of the engine. An illustrated description of these engines appeared in our issue of August 28th.

We understand that Kitson and Co., Ltd., have completed the trial cylinder and gear of the Kitson-Still locomotive and have made some tests with it. The particulars are not yet available.

Amongst the engines turned out by the North British Locomotive Company, Ltd., during the past year four modified "Fairlies," which were shipped to South Africa for the Government Railways, are perhaps the most interesting. The order for these engines resulted from the success attained by the single engine of the same type, but lighter build, which was sent to South Africa in 1924. This engine was tested officially on a 50-mile run with a ruling gradient of 1 in 55, hauling on one occasion a goods train of 504 tons and on another a passenger train of 294 tons. It showed remarkable steadiness in traversing curves, taking a 400ft. curve at 30 miles per hour and a 300ft. curve at 25 miles per hour.

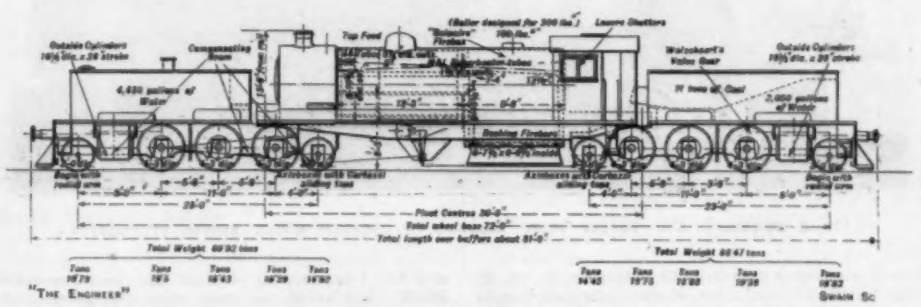


FIG. 7—INDIAN STATE NORTH-WESTERN RAILWAY, GARRATT ENGINE—WEIGHT DIAGRAM

The characteristics of the "Modified Fairlie" are well shown in the illustration of the new South African engines—see Supplement. The boiler, the tanks and bunker are all carried on a single long frame, or "Fairlie cradle," and the two "engines" are supported on bogies

which are pivoted to the cradle. The arrangement permits of the use of a large boiler, whilst the employment of two bogies gives that easy movement on curves to which we have referred. Another important advantage is that the complete "cradle" can be lifted from the bogies, thus making all parts readily and rapidly accessible.

The four new engines for South Africa, 3ft. 6in. gauge, have each four 15in. by 24in. cylinders, driving 3ft. 9½in. coupled wheels with a working pressure of 180 lb. Thus at 75 per cent. boiler pressure they develop a tractive effort of over 32,000 lb. The total weight in working order is 114 tons 2 cwt., of which nearly 73 tons are carried on the drivers. The boiler has the large grate area for a narrow-gauge engine of just upon 41 square feet, an evaporative surface of 1745 square feet, and superheater area of 362 square feet.

The North British Locomotive Company, Ltd., also turned out an "Atlantic" passenger engine for the Egyptian State Railways, 4ft. 8½in. gauge. It has two 20in. by 28in. cylinders, driving 6ft. 6in. coupled wheels. The boiler pressure is 160 lb. and at 75 per cent. of it the tractive effort is 17,230 lb. In working order the engine weighs 76 tons 7 cwt., with 18 tons on each driving axle. The boiler has an evaporative surface of 1726 square feet and 472 square feet of superheater surface. The turbine locomotive exhibited by the North British Locomotive Company at Wembley in 1924 will be remembered by our readers. It underwent test bed and yard trials during last year and satisfied its makers that on the crucial point, the condenser, it was quite satisfactory, a vacuum of 28in. being maintained with the engine at rest.

We learn from Peckett and Sons, Ltd., Bristol, that they constructed during the year two special locomotives with 10in. cylinders, one for a quarry railway of 2ft. 8in. gauge in the South of England, and one of 3ft. 6in. gauge for a cement works in New Zealand. The first of these is the saddle tank engine shown in Fig. 9. Its 10in. cylinders have a stroke of 15in., and work at a pressure of 170 lb., driving 2ft. 6½in. coupled wheels. The height and width of the engine are strictly limited to 9ft. 6in. and 7ft. respectively. The engine is furnished with a Bissel truck and as the rigid wheel base is only 4ft. 3in., the sharp curves that are familiar in quarry railways can be easily traversed. The engine in running order, with 500 gallons in the tank and 18 cwt. in the bunker, weighs 21 tons.

The second engine referred to is a little "side-tanker," with the same sized cylinders, but the boiler pressure is 160 lb. instead of 170 lb., and the driving wheels are 2ft. 9in. instead of 2ft. 6½in. The weight of the engine loaded, with 400 gallons of water in the tanks and 22 cwt. of coal in the bunkers, is 20¾ tons. The six-coupled wheel arrangement gives a rigid base of 9ft. 9in.

In the first half of 1925 Robert Stephenson and Co., Ltd., Darlington, completed five eight-coupled goods engines for the Somerset and Dorset Joint Line of the London, Midland and Scottish Railway, to the designs of Mr. George Hughes and Sir Henry Fowler. These engines, of which a photograph is reproduced in Fig. 10—have 21in. by 28in. cylinders and 4ft. 7½in. driving wheels. The boiler pressure is 190 lb., and at 85 per cent. of it the tractive effort is practically 36,000 lb. The evaporative surface is 1471 square feet, and the grate area 28·4 square feet. A superheater, with 374 square feet of surface, is fitted. It is of interest to note that the axle load is only 16 tons, and the total weight of the engine in running order 68 tons 11 cwt. Those who visited the Railway Centenary Exhibition at Darlington will recall that one of these locomotives stood near a working model of "No. 1," thus showing a hundred years of progress made by the builders.

The firm also turned out twenty tank engines to the design of Mr. H. N. Gresley for the London and North-Eastern Railway. They have cylinders 18in. by 24in., 4ft. 10in. driving wheels, and a working pressure of 180 lb., and weigh in working order 63 tons 13 cwt.

For foreign orders Messrs. Stephenson have now under construction six "Prairie" type engines for the Sudan Government Railways, identical with those described fully in our issue of September 4th. We learn that these engines have proved very successful, hauling loads of 900 tons and steaming freely. Two "Mikados" for the same railway and six 2–8–4 tank engines for the Uganda Railways are also in hand.

The eight-coupled locomotive—illustrated in Supplement—is the most interesting engine turned out by the Vulcan Foundry, Ltd., of Newton-le-Willows, in the past year. Five of the type were completed for the Nigerian Railway. That railway has a gauge of 3ft. 6in., and as the engine and tender weigh nearly 126 tons, it will be seen at once that the locomotive is one of exceptional proportions. It has three cylinders, 18in. by 28in., driving 4ft. 6in. wheels, with a boiler pressure of 180 lb. The tractive effort at 90 per cent. is therefore about 41,000 lb., and at 75 per cent. about 35,000 lb. The boiler has an inside diameter of 5ft. 5¼in., and the great length of 22ft. 5in., but in order to avoid excessive tube length, the fire-box is provided with a combustion chamber, which projects into the barrel, reducing the length between tube-plate to 19ft. 6in. The fire-box is very wide, namely, 4ft. 10in., with the result that the frames had to be widened at the hind end. The grate area of this box is 38 square feet, and its heating surface 210 square feet. The total evaporative surface is 2290 square feet, and a Robinson superheater, with 506 square feet of surface is fitted. The two outside valve gears are of the Walschaerts type driving valves above the cylinders. In the third cylinder, inside, the valve is below, and it is operated by a system of cross levers from the outside valve spindles. The leading truck is of the swing link type with inside bearings, and the trailing truck is of the built-up radial type. It will be observed that it has outside bearings.

Amongst other engines built during the year by the Vulcan Foundry, we may mention thirty-six 4–8–0's for the Uganda Railway, and twenty-five 2–6–4 tank engines for the Buenos Ayres Great Southern Railway.

The most interesting engines built by the Yorkshire Engine Co., Ltd., of Sheffield, were five oil-burning locomotives for the Central Railway of Peru; a photograph of one is reproduced in Fig. 11. These engines have to face a gradient of 1 in 25 with short stretches even more severe for a continuous length of 75 miles. Hence they have very large boilers, barrels 6ft. in diameter, with a total evaporative area of 2470 square feet and a superheater area of 486 square feet. The driving wheels are 4ft. 4in. in diameter, and the cylinders 20in. by 28in. A working pressure of 180 lb.

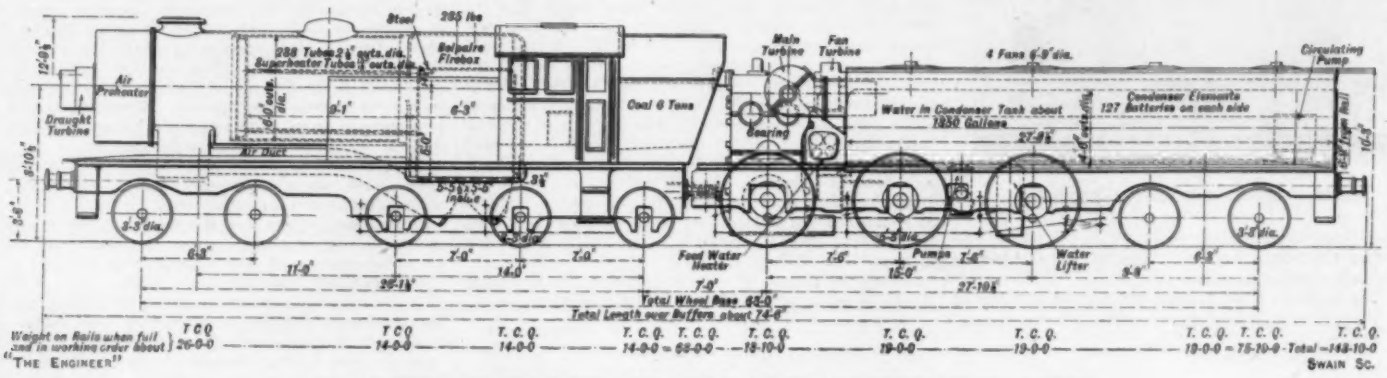


FIG. 8—EXPERIMENTAL LJUNGSTROM TYPE GEARED TURBINE LOCOMOTIVE—BEYER, PEACOCK

FIG. 9—SADDLE TANK ENGINE—PECKETT

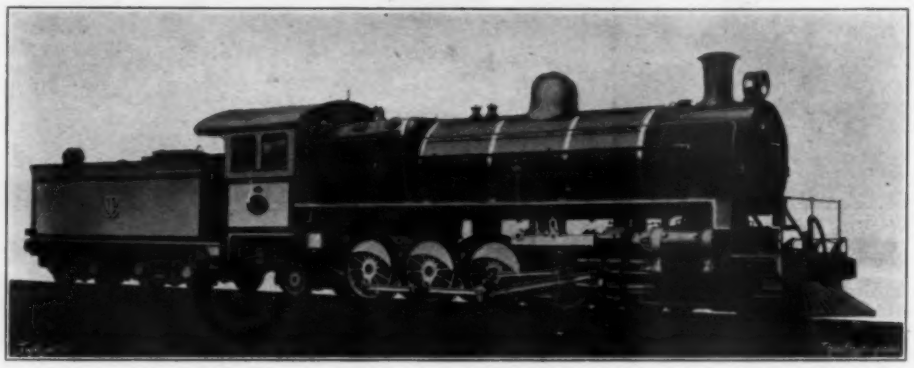


FIG. 11—CENTRAL RAILWAY OF PERU, OIL BURNING ENGINE—YORKSHIRE ENGINE COMPANY

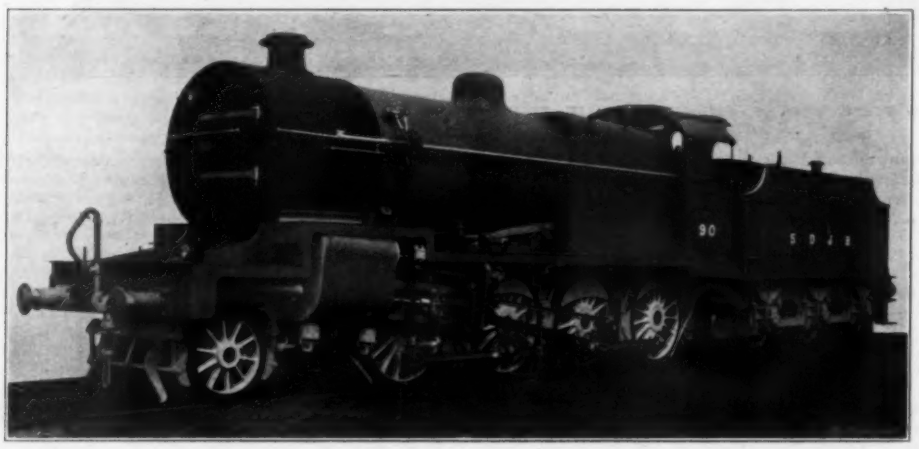


FIG. 10—SOMERSET AND DORSET JOINT RAILWAY, 8-COUPLED GOODS ENGINE—STEPHENSON

is carried, and the tractive effort at 75 per cent. is therefore about 29,000 lb. The double bogie tender has a horse-shoe water tank, carrying 4000 gallons, with an oil tank of 1230 gallons capacity between the legs. The total weight of engine and tender is 123 tons 8 cwt. The engines were constructed to the specifications and inspection of Messrs. Livesey, Son, and Henderson, of London, consulting engineers to the Central Railway of Peru.

Considering the depressed condition of the loco-

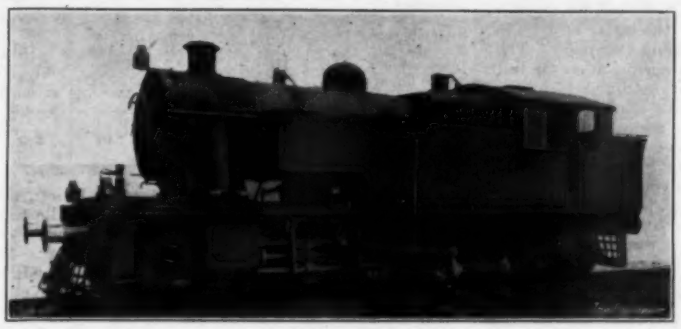


FIG. 12—INDIAN STATE RAILWAYS, TANK ENGINE—HAWTHORN LESLIE

motive industry generally, R. and W. Hawthorn, Leslie and Co., Ltd., tell us that they were kept fairly well employed during the period under review. Early in the year four heavy tank locomotives of the 2–8–2 type were delivered to the Indian State Railways, Oudh and Rohilkund section; these engines have outside cylinders, 22in. diameter by 26in. stroke, and a general view is given in Fig. 12. Two 5ft. 6in. gauge locomotives, with 15in. by 26in. cylinders and double bogie tenders, were supplied to the order of the Crown Agents for the Colonies for the Ceylon Railways. Three metre gauge locomotives of the 4–6–2 type with six-wheeled tenders were sent to the Gondal Railway, to the requirements and inspection of Messrs. Robert White ans Partners. These locomotives are known as the old "P" class, and have cylinders 15in. dia. by 22in. stroke. A batch of 4–6–2 type heavy tank locomotives was delivered to the London and North-Eastern Railway, and others are in hand for delivery early in the coming year. A heavy six-wheels coupled side tank locomotive with cylinders 18in. by 24in., for 5ft. 6in. gauge, was shipped to a large industrial concern in India. Two 17in. tank locomotives were supplied to the same company previously. A similar type of industrial locomotive was also shipped to Singapore. It has four wheels coupled, and the cylinders are 12in. diameter by 19in. stroke.

During the year the preliminary experiments on the 300 horse-power thermo-electric locomotive which the firm has built for research purposes were completed, and the locomotive was dismantled with a view of trying the latest developments, viz., the "Paragon B. and B" electric system.

During the year Sir W. G. Armstrong, Whitworth and Co., Ltd., completed a good deal of locomotive building. Amongst the railways supplied were the Bengal-Nagpur, the Buenos Ayres Great Southern, the Therezopolis, the Metropolitan, the Southern, and the South Australian. For the latter 4–6–2, 4–8–2 and 2–8–2 engines, all with double-bogie tenders, were constructed. Of the three last named we illustrate the six-coupled engine by a reproduction of a photograph Fig. 13. The engines are interesting, because they visualise the standardisation of the Australian railway gauges. The gauge of the South Australian is 5ft. 3in., and these engines have been built to conform with it; but they are so designed that they may be converted to 4ft. 8½in. at a minimum cost. In the "Pacific," which we illustrate, and the 4–8–2, or "Mountain" type, the middle course of the boiler is tapered to reduce the diameter from 7ft. 0½in. at the fire-box end to 6ft. 2½in. at the smoke-box end. The fire-box has, it will be seen, a round top, and the inner box is carried forward a short distance into the barrel, the length between tube plates being thus kept down to 18ft. 11in. A hand-operated rocking grate with a front drop grate is fitted. In the "Mountain" type the coal is fed by a duplex mechanical stoker or by hand, but in the other two engines by hand only. The engine frames are of cast steel bar type machined all over, with rear extensions spliced on. In the "Mountain" engine the front buffer beam is of cast steel, but in the other two engines it is of the usual built up form.

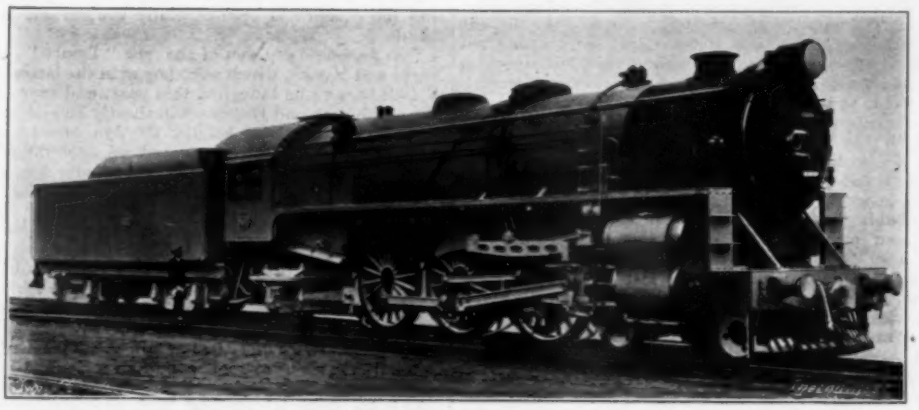


FIG. 13—SOUTH AUSTRALIAN RAILWAYS, SIX-COUPLED ENGINE—ARMSTRONG, WHITWORTH

The "Pacific" engine has a total evaporative surface of 3223 square feet and a superheater surface of 743 square feet. With 200 lb. pressure in the boiler it develops at 85 per cent. a tractive effort of 36,600 lb., the cylinders being 24in. by 28in., and the drivers 6ft. 3in. in diameter. The total weight of engine and tender is just 200 tons. The "Mountain" type has 22in. by 28in. cylinders, driving 4ft. 9in. wheels, and develops 40,400 lb. tractive effort, whilst the "Mikado" gives 51,000 lb. on 5ft. 3in. wheels with 26in. by 28in. cylinders. In running order it weighs nearly 219 tons. Its boiler is bigger than that of the other engines, being 21ft. long between tube-plates, and having an evaporative surface of 3609 square feet and 835 square feet of superheater surface. Its grate area is 66·5 square feet, as compared with 55 of the "Pacific" and 47 of the "Mountain" type.

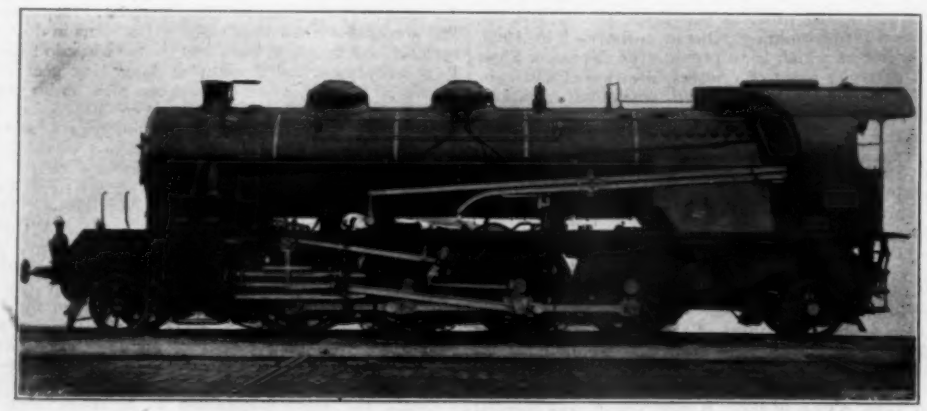


FIG. 14—P. L. M. RAILWAY, 8-COUPLED COMPOUND ENGINE

French Locomotives.

We have already referred to the fact that in France eight-coupled engines are being used for passenger traffic, and in one of our Supplements to-day we reproduce photographs of the Paris–Orleans and P.L.M. engines of that type. The former is a simple, with 24.5in. by 27.5in. cylinders, driving 5ft. 11in. wheels, with a boiler pressure of 170 lb. American influence may be observed in the design. They are being used on the Paris-Tours-Bordeaux and Limoges-Montauban lines for both passenger and fast goods trains. The loads of goods trains run up to 600 tons behind the tender, and speeds up to 25 miles per hour are reached.

The 4–8–2 P.L.M. is a compound, with outside high-pressure cylinders 20.3in. by 26.0in., and inside low-pressure cylinders 28¾in. by 28in. The driving wheels are 4ft. 11in. in diameter and the total weight of the engine alone 117 tons. A boiler pressure of 228 lb. is used. This engine has touched nearly 67 miles per hour with a 600-ton train. Another eight-coupled P.L.M. engine is shown in Fig. 14. It has the same cylinders as No. 241 A 1, but the driving wheels are smaller, 5ft. 5in. instead of 5ft. 11in. The boiler is also a good deal smaller, with the result that the weight is 93½ tons, instead of 117 tons. We understand that the Est Railway is also trying an eight-coupled engine.

Naval Construction in 1925.

IMPORTANT developments in the field of man-of-war construction took place during the past twelve months. Apart from the launching of noteworthy vessels at home and abroad, the year was memorable for the introduction of a long-term building programme for the British Navy, having in view the systematic replacement of obsolete ships, as well as for the steady progress of warship construction in foreign countries. The volume of new combatant tonnage which went afloat during the year exceeded by a substantial margin that of any year since 1921, and approximated to 300,000 tons, more than half the total being represented by comparatively small vessels, ranging from cruisers to submarines. While it would certainly be premature to speak of a new competition in naval armaments, there are signs of a universal reawakening of interest in problems of sea power, which finds expression in a more energetic shipbuilding policy. Proof of this may be found, not only in the activity prevailing in the dockyards of the major Powers, but in the efforts which nearly every maritime State of secondary rank is making to augment its naval forces. Argentine, Brazil, Chile, Germany, the Netherlands, Soviet Russia and Turkey have one and all announced building programmes which may or may not come to fruition. On the other hand, the economic causes which have done so much to delay the post-war renovation of navies are still in operation. Shipbuilding costs remain extremely high, and show no tendency to decline. Capital ships of the latest type cannot be built for less than £7,000,000 apiece. A cruiser of the standard 10,000-ton class costs about £2,500,000, or as much as a pre-war battleship. The modern destroyer is as expensive as a light cruiser was in 1914, and submarines have belied their former reputation for cheapness by costing from £350,000 to £950,000, according to tonnage. In these circumstances the creation of even a small navy of modern units must impose a severe strain on the exchequer of any State, and the wonder is, not that the present output of new fighting tonnage should be so much less than in pre-war years, but that it should be as large as it is.

British Empire.

The battleships Nelson and Rodney, authorised in the Navy Estimates for 1922–23 and laid down simultaneously on December 28th, 1922, were both launched, the former by Sir W. G. Armstrong, Whitworth and Co., at Walker-on-Tyne, on September 3rd, the latter by Cammell, Laird and Co., Ltd., at Birkenhead on December 17th. Although nothing beyond the bare dimensions has been officially disclosed the general features of these ships are now fairly well known. It will therefore suffice to record such particulars as appear to be reliable, and for purposes of comparison the corresponding data of other battleships are given in the Table overleaf.

In the absence of information as to the armour protection of the "Nelsons," it would be futile to extend the foregoing comparison. The figures given, however, leave no doubt that in the new vessels we shall possess the two most powerful battleships which have yet been designed. They are the last ships of capital rank which we are entitled to build until the year 1931, when two further vessels of 35,000 tons may be laid down.

Before proceeding to describe other ships of the

year, reference must be made to the shipbuilding programme which was announced in July. It provides for the following new units up to the financial year 1929–30 inclusive:—In 1925–26: Four "A" class cruisers (10,000 tons), four gunboats, one floating dock. 1926–27: Two "A" class cruisers, one "B" class cruiser (8000 tons), six submarines, two depôt ships, four motor launches. 1927–28: One "A" cruiser, two "B" cruisers, nine destroyers, six submarines. 1928–29: One "A" cruiser, two "B" cruisers, nine destroyers, six submarines, one gunboat. 1929–30: One "A" cruiser, two "B" cruisers, one aircraft carrier, nine destroyers, five submarines, one fleet submarine, one net-laying ship. The total cost of this programme is estimated at £58,000,000, of which £37,670,000 will fall on the Navy Estimates from the current year to 1929–30 inclusive. Large as these sums may be, they will be balanced in part by retrenchment in other directions which the methodical provision of new material will render possible. This aspect of the matter was explained by the First Sea Lord in his speech at the

Comparative Table of Battleships.

	Nelson class.	Royal Sovereign.	U.S.S. Colorado.	Japanese Mutsu.
Laid down	1922	1913–14	1919	1918
Length, feet	702	614	600	700
Beam, feet	106	88½*	97½	95
Draught, feet	30	28½	30½	30
Displacement, tons	35,000	25,750	32,600	33,800
Speed, knots	23 (?)	23	21	23
Guns	9—16in., 50 cal., 12—6in.	8—15in., 42 cal., 14—6in.	8—16in., 45 cal., 12—5in.	8—16in. 45 cal., 20–5·5in.

* Original breadth, since increased by the addition of bulges.

Lord Mayor's Banquet in November, in the course of which he said: "The Admiralty have during the past four or five years advocated continually the adoption of a steady programme of replacement for naval defence, but owing to the instability of the various Governments, who have never lasted more than a few months, no programme has been accepted, and therefore no programme adopted. Obviously, it is far more economical to have a steady programme than to do as we have had to do in the last five years. The present Government, with its prospects of stability, has been able to accept a definite programme, and so by stabilising expenditure on naval construction it has enabled the Admiralty to exercise economies which would not have been possible under the previous circumstances. The effects are far-reaching, and include the demolition of many older ships now on the active list, with a corresponding reduction of expenditure on repairs, maintenance, and *personnel*."

Normal progress was made during the year on the five "County" class cruisers of the 1923–24 Estimates, all of which were laid down in the period September–November, 1924: the Cornwall at Devonport, the Suffolk at Portsmouth, the Kent at Chatham, the Berwick by the Fairfield Company at Govan, and the Cumberland by Vickers Ltd., at Barrow-in-Furness. It is probable that all five ships will go afloat in the first half of this year. Two cruisers of the same design as the "Counties," to be named Australia and Canberra, are under construction by John Brown and Co., Clydebank, to the order of the Australian Government. Nothing is known about these seven ships save that they will displace 10,000 tons and carry 8in. guns. Failing official data, we quote the following interesting comments on British cruiser design from the new edition of "Nauticus," the German naval year-book: "It is probable that the 8000-ton 'B' ships will be a development of the 'Emerald' class, and the 10,000-ton 'A' ships an improvement on the 'Raleigh' class. Regarded purely as a fleet scouting cruiser, the Emerald, with her 7600 tons displacement, is unduly large. The improved 'Raleighs' would be useful as a support for the light scouting forces with the Fleet, now that no further fast battle-cruisers are to be built. Presumably, therefore, the new cruisers will represent an advance in speed in the 8000-ton class and an improvement in gun power in the 10,000-ton class. No change is likely to be made in the system of armour protection, which is common to both classes. We may thus expect to see an improved 'Emerald,' or 'B' class, with eight 6in. guns in twin turrets, instead of the seven 6in. on single mountings, and with a speed of 35 knots instead of 33. The larger 'A' type may have eight 8in. guns in twin turrets and a speed of 31 to 32 knots."

Four additional "County" cruisers are to be laid down under the current Estimates, one at Portsmouth and Devonport respectively, and the other two in private yards. Two new destroyers are under construction, the Ambuscade having been laid down by Yarrow and Co. on December 8th, 1924, and the Amazon by Thornycroft and Co. in January, 1925. No particulars are available. A submarine, the O 1, of 1480 tons surface displacement, is on the stocks at Chatham, and two submarines for the Australian Government were ordered last year from Vickers Ltd., to cost £300,000 each for hull and machinery. The large cruisers Glorious and Courageous are being rebuilt as aircraft carriers, and when completed may resemble the Furious, of which they were originally sister ships. The cruisers Effingham and Emerald, which were completed during the year, have already been described in our columns. We regret that the Admiralty has not seen fit to release any details of their steam trials, though considerable interest attaches to the performance of the Emerald as the first 33-knot cruiser to be completed for the Royal Navy.

United States.

Two aircraft carriers, Saratoga and Lexington converted from battle-cruiser design, were launched during the year, the former on April 6th by the New York Shipbuilding Corporation, the latter on October 3rd by the Fore River Shipbuilding Company. They are the largest vessels of any description so far built in the United States. In their modified form they have the following dimensions:—Length over all, 888ft.; extreme breadth, 106ft.; mean draught, 22ft.; normal displacement, 33,000 tons. Each is propelled by four sets of General Electric turbines, with electrical transmission, generating a total of 180,000 shaft horse-power, for a speed of 34.5 knots, steam being supplied to the turbines by sixteen Yarrow boilers in the Saratoga and the like number of White-Forster boilers in her consort. The propelling machinery is the most powerful which has yet been installed in any vessel. The arrangement of the superstructure generally resembles that of H.M.S. Hermes. A single funnel of immense size is placed at the extreme starboard side of the deck. Before it are the bridges, surmounted by a stump lattice mast, and two gun turrets. Abaft the funnel are two more turrets. By this arrangement all but a small part of the flight deck is left clear for aviation purposes, the deck having a total area of 5 acres. Protection is afforded by vertical and horizontal armour, and bulges are fitted. The armament is very powerful for ships of this type, consisting of eight 8in. 55-calibre guns paired in turrets, and twelve 5in. A.A. guns mounted on the broadside at the stern in two groups of six each. Each vessel is to carry seventy-two aeroplanes. The total cost is reckoned at over £9,000,000 per ship. Both will be completed before the end of the present year. Two of the eight 10,000-ton cruisers authorised during the last session of Congress were laid down on or about October 1st. The design is still confidential, but it is to be doubted whether these ships will carry the abnormal armament of twelve 8in. guns with which they have been unofficially credited. A battery of this weight would be incompatible with the very high speed which is universally accepted as a *sine qud non* in modern cruising ships, and would, moreover, probably involve the sacrifice of even the very light armour protection for which contemporary designs of the "Treaty" cruiser class are understood to provide. Submarine V 3, the last of a trio of large fleet boats, was launched on June 9th. These are the heaviest submarines yet constructed in America, and are intended to accompany the battle fleet on all occasions. Length overall, 341½ft.; breadth, 27½ft.; draught, 15½ft.; displacement, 2164 tons on the surface, 2520 tons submerged; Busch-Sulzer motors of 6500 brake horse-power, for a surface speed of 21 knots. Armament, one 5in. gun on a high-angle mounting, six tubes and sixteen torpedoes. Great radius of action is a feature of the design. A still larger submarine, V 4, was begun on May 1st. It is stated that she will displace 3000 tons on the surface, *i.e.*, 220 tons more than the British X 1, at present the largest submarine in existence. The V 4 is a mine-layer, but will also carry guns and torpedoes. Others of the class will be laid down when the necessary appropriations are made.

Japan.

Uninterrupted progress was made throughout the year with the building scheme authorised in 1922, the object of which is to provide the Japanese Fleet with a strong force of cruisers, destroyers and submarines, to compensate for its weakness in capital ships. The largest vessel to take the water was the aircraft carrier Akagi, which went afloat at Kure on April 22nd. Laid down in 1920 as a battle-cruiser, she was among the ships condemned under the Washington Treaty, but was subsequently retained for conversion into an aircraft carrier in place of the Amagi, which was destroyed in the earthquake of September, 1923. The Akagi has the following dimensions, &c.:—Length, 763ft.; beam, 92ft.; draught, 21ft.; displacement, 26,900 tons; designed speed, 28·5 knots. She will be armed with ten 8in. guns and sixteen 4·7in. guns, most of the latter on high-angle mountings. Three light cruisers were launched during the year, the Naka on March 25th, the Furutaka on February 26th, and the Kako on April 10th. The Naka, a unit of the "Kuma" class, was delayed in construction owing to damage she sustained in the earthquake. She is the fourteenth and last of a series of ships which are virtually standard in dimensions, armament and speed, forming a uniform group of swift scouting cruisers which has no counterpart in any other navy. The displacement is 5500 to 5600 tons, the sea speed 33 knots, and the armament seven 5.5in. guns. In the Furutaka and the Kako a much more powerful type of cruiser is represented, and one that is of special interest as reflecting Japanese ideas of what may be done without going to the limit of 10,000 tons allowed by the Treaty. The Kako and her three sisters—Kinugasa and Aoba are not yet launched—were planned in the first instance as 6000-ton ships, to be armed with 5.5in. or 6in. guns. After the Washington Conference, however, the design was recast on a basis of 7100 tons, and other radical changes were made. In the following table the Kako is compared with various foreign cruisers of approximately the same displacement:—

	I.J.N. Kako.	H.M.S. Emerald.	U.S.S. Omaha.	Spanish P. Alfonso.
Launched	1925	1920	1920	1925
Length, feet	595	570	555	579
Breadth, feet	50½	54½	55	53
Draught, feet	12	16½	14½	16½
Displacement, tons	7100	7600	7500	7850
Speed, knots	33	33	33½	33
Guns	6—8in., 4—3in.	7—6in., 3—4in.	12—6in., 4—3in.	8—6in., 4—4in.
Weight of broadside, lb. (main guns only)	1500	600	840	800

As will be seen from the foregoing tabulation, the Japanese ship, though considerably the smallest of the four, has by far the heaviest broadside, and—on paper at least—is easily first in fighting power. So far as British naval requirements are concerned, it seems to us that a slightly larger version of the Kako, say, 8000 tons, with an armament of six 8in. or 7·5in. guns paired in turrets, would be preferable to an improved Emerald mounting only 6in. guns. If the Kako proves to be a steady gun platform, it would be impossible for any cruiser armed with 6in. ordnance to approach her without running the risk of summary destruction, for in range, precision and smashing effect, the 8in. gun is incomparably superior to the 6in. Nor need the Kako shrink from a duel with a "Treaty" cruiser of 10,000 tons. It remains to be seen, however, whether the mounting of this relatively tremendous armament in a ship of only 7100 tons has not involved some loss of seaworthiness and stability. At the same time, the reputation of Japanese naval constructors is a sufficient guarantee that the design has been carefully worked out in all details.

Two Japanese cruisers of the new "Treaty" class, Nachi and Myoko, which were begun in the latter part of 1924, are to be launched this year, and two sister ships, Ashigara and Haguro, will shortly be laid down. The type is 600ft. in length, 60ft. in breadth, and displaces 10,000 tons. A speed of 33·5 knots is specified. The main armament will be nine 8in. guns in triple turrets, two forward and one aft. Several first-class destroyers of 1400 tons and 34 knots speed were launched in the course of the year; others are building. The construction of submarines was also pressed forward, and the year was notable for the completion of the large I 51, one of a group of boats designed for oversea service. They have a surface displacement exceeding 1500 tons, and a nominal cruising endurance of 12,000 miles. A supplementary shipbuilding programme, comprising four 10,000-ton cruisers and many smaller craft, has been postponed for financial reasons, and new construction this year will be limited to a few destroyers.

France.

No news has yet been received of the trials of the three French 8000-ton cruisers—Duguay-Trouin, Lamotte-Picquet and Primauguet—all of which should have hoisted the pendant last year. Their performance on trial is awaited with special interest, as the machinery is designed for 100,000 shaft horse-power, a figure never before approached in a French man-of-war. Leading particulars of the class are as follows:—Length over all, 604ft.; beam, 56½ft.; draught, 17½ft.; normal displacement, 7880 tons. The armament consists of eight 6·1in. guns in double turrets, four 3in. A.A. guns and twelve torpedo tubes. Two aeroplanes and a catapult launching gear are provided. Two heavier cruisers are now under construction, the Tourville having been laid down at Lorient in August, 1924, and the Duquesne at Brest on October 30th, 1924. The last-named vessel was launched on December 17th. They are 607ft. in length, 63ft. in breadth, displace 10,000 tons, and have machinery of 130,000 shaft horse-power. The main armament is to be eight 8in. guns. A third and similar ship, Suffren, was begun at Brest in December, and a fourth and fifth are projected. Both in the 8000-ton and the 10,000-ton class, armour has been virtually dispensed with in favour of the highest attainable speed. Several of the big 2362-ton flotilla leaders of the "Jaguar" class have recently made their trials, in every case with success. According to an official report of the Commission d'Essais, the Tigre maintained 35·93 knots, with a mean of 52,000 shaft horse-power for eight consecutive hours, in a disturbed sea and a stiff breeze. In the ninth hour a speed of 36·70 knots was reached with 58,000 shaft horse-power. The fuel consumption was remarkably low, and it is estimated that these boats have a radius of 4000 miles at economical speed. The reduction gearing for the Tigre and three of her consorts—Jaguar, Chacal, Panthère—was designed and manufactured by a British firm, the Power Plant Company, Ltd., of West Drayton, Middlesex, which has received gratifying reports of the behaviour of the gears. The same firm, it is interesting to learn, is supplying the reduction gears

for the cruisers Duquesne and Tourville, referred to above. The six flotilla leaders of the "Jaguar" class constitute a homogeneous light squadron of remarkable speed and power. Their sea speed may be taken as 35 knots, they carry five 5·1in. guns and six torpedo tubes, and they are large enough to keep the sea in almost any weather. Fifteen more leaders, of a slightly heavier type, are to be built. Equally satisfactory were the trials of the 1430-ton destroyers, eighteen of which are already afloat. The nameship, Simoun, averaged 33·20 knots on an eight-hour run, and 34·30 knots for one hour during her trials in boisterous weather. Others of the class are said to have done still better. They are armed with four 5·1in. guns and six tubes. Six further boats of this class were laid down in 1925.

Many French submarines were launched in the past year, including the Narval, Dauphin, and Marsouin, all of 1130 tons surface displacement and 16 knots speed. In all, nine units of this class are ready or approaching completion. Six larger boats—Redoutable, Vengeur, Henri Poincaré, Poncelet, Pasteur, and Pascal—with a displacement of 1550 tons and a speed of 18 knots are under construction. The first pair is to be equipped with two two-cycle Sulzer motors of 3000 brake horse-power. Twelve small submarines of the "Ariane" coast defence class, 600 tons and 14 knots, are being completed. In the present year it is proposed to lay down seven more submarines of the "Redoutable" group and two submarine minelayers. Although some delay has occurred in the completion of the cruisers, the French building programme is, on the whole, maturing according to plan.

Italy.

The cruisers Trieste and Trento, building at Trieste and Leghorn respectively, have already been described in THE ENGINEER. Their displacement is 10,000 tons, and they are to have geared turbine installations of no less than 150,000 shaft horse-power. Sixteen new destroyers are building in various yards. They average 1250 tons displacement with 35·5 knots speed, and will be armed with four 4·7in. guns and six tubes. Other construction in hand includes four submarines of 1360 tons and eight of 800 tons.

Minor Navies.

The Spanish cruisers Principe Alfonso and Almirante Cervera were launched at Ferrol, the first on January 23rd, the second on October 16th. Designed by Sir Philip Watts, of Armstrongs, they are ships of 7850 tons and 33 knots, armed with eight 6in. guns. In form and dimensions they bear a close resemblance to our "Emerald" class.

Four destroyers of an uncommonly powerful type are in hand for the Netherlands Navy. They are being built in Holland to the designs and under the supervision of Yarrow and Co., Ltd., who are also supplying boiler material and certain other parts of the machinery. Particulars are as follows:—Length, 322ft. over all; displacement, 1620 tons; Parsons geared turbines and Yarrow boilers for 31,000 shaft horse-power, and 36 knots. Armament, four 4·7in. guns, two 3in. A.A., six tubes. The Yarrow design was selected by the Dutch authorities out of a number submitted by firms in Great Britain, on the Continent, and in the United States.

Some further official details have reached us of the new German cruiser Emden, which was recently described and illustrated in our columns. The length on the water-line is 484ft., extreme breadth 46¾ft., normal displacement 6000 metric tons. Electric welding was extensively used in the construction of the hull, this being the first time, it is believed, that the process has been employed in a large man-of-war. The machinery consists of two sets of turbines with reduction gearing. The high-pressure turbines make 2435, the low-pressure turbines 1568, and the propellers 295 revolutions per minute at full power. There are four coal-burning boilers and six single-ended oil-fired boilers, housed in four compartments. At the time the ship was ordered it was deemed inadvisable to design her on an all-oil basis. She is expected to maintain a speed of 27½ knots for long periods under reasonable weather conditions. The eight 5·9in. 50-calibre guns comprising the armament were taken from the reserve permitted by the Versailles Treaty. Twin mountings are now being manufactured, and when they are ready the ship will have her eight guns rearranged in pairs along the centre line. A new system of fire control, embodying war experience, has been fitted. The foremast, which carries the gun director tower, has a diameter of no less than 60in. Davits have been eliminated, all the boats being lowered and hoisted by derrick booms pivoted on the foremast. The living quarters are superior to those of any preceding German warship, special attention having been given to this feature in view of the fact that the *personnel* of the German Navy is now on a long-service footing. A second cruiser of similar design is to be laid down this year at Wilhelmshaven, the Reichstag having voted the initial grant for the purpose. One new destroyer of 800 tons is on the stocks, and five more boats will shortly be laid down.

Steamships in 1925.

ALTHOUGH the shipbuilding industry was marked by severe depression and increased foreign competition was felt, it is undoubtedly true that at the close of the year the industry was in a much better position to take advantage of a revival in trade or to meet competition from abroad than when the year began. Actually, as is always the case, even in the most difficult of years, much was done and some notable ships were built. We do not propose to give particulars of the actual returns for tonnages and engines built in the different districts, but rather to follow our usual custom and to indicate some of the more outstanding vessels of the year and those directions in which development took place.

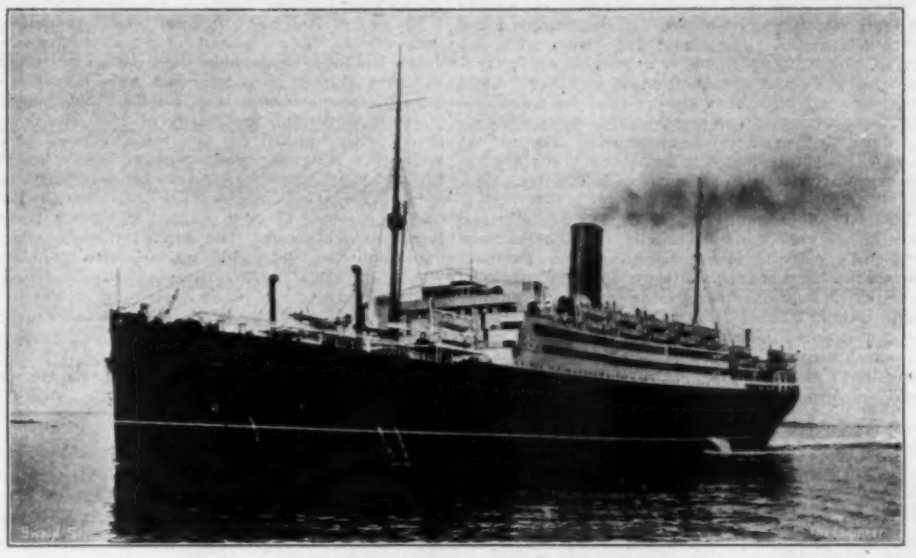


FIG. 1—CUNARD LINER CARINTHIA

British Built Liners.

Several of the large shipping lines completed their post-war building programmes. The Cunard Line put into service three new liners, all of the single-funnel class. The Ascania and Alaunia, built by Sir W. G. Armstrong, Whitworth and Co., Ltd., and John Brown and Co., Ltd., respectively, are both 14,000-ton ships with an overall length of 540ft., a breadth of 65ft., and a depth of 43ft. The twin-screw turbine propelling machinery of these ships is of the Parsons type with double reduction gears, and the total shaft horse-power developed at 90 revolutions of the propeller per minute is about 8500. Steam is supplied at a working pressure of 220 lb. per square inch and the four boilers, which are installed in each ship, have a heating surface of about 19,900 square feet and are designed to burn oil fuel. The liner Carinthia, illustrated in Fig. 1, was built and engined by Vickers Ltd. She is a 20,277-ton ship with a length of 600ft., a breadth of 73ft. 6in., and a depth of 45ft. As regards her general design she is a sister ship to the Franconia and is specially fitted out for world cruises. Again, her propelling machinery is of the geared turbine type and consists of twin-screw Parsons marine turbines with double reduction gearing. With a propeller speed of 90 revolutions the total output of the turbines is about 13,500 shaft horse-power. Three double-ended and three single-ended boilers designed for a working pressure of 220 lb. per square inch and arranged for oil firing to provide the steam.

Another ship which was built at Vickers' yard and which will start on her maiden voyage early this year is the Otranto, for the Orient Steam Navigation Company. She is a sister ship to the Orama, also built by Vickers, and to the Oronsay, which was completed by John Brown and Co., Ltd., at Clydebank early in the year. The Oronsay was described in the issues of THE ENGINEER of February 13th and 20th. She is a 20,000-ton ship and is propelled by twin-screw single reduction geared turbines of the Brown-Curtis type designed for an output of 20,000 shaft horse-power when supplied with steam at 215 lb. working pressure. The Oronsay is to be used for cruises in Northern waters during the present year.

The Peninsular and Oriental Steam Navigation Company added no less than seven liners to its fleet, in addition to the Harland and Wolff liner Razmak, which, although completed during 1924, was commissioned last year for the company's Bombay-Aden mail service. Of the seven new liners, four are of the "Ranchi" class, illustrated in one of to-day's Supplements, and were built for the P. and O. Indian mail service and, the other three are of the "C" class for the Australian mail service. The "R" or "Ranchi" class of liners are 570ft., 16,600-ton vessels, equipped with twin-screw balanced quadruple-expansion steam engines designed for a total output of about 15,000 indicated horse-power. Oil-fired boilers with a working pressure of 215 lb per square inch are

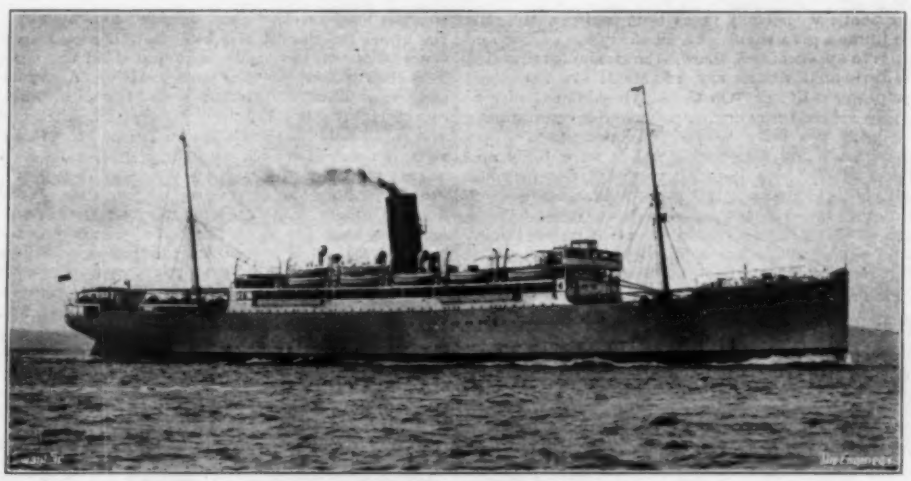


FIG. 2—UNION-CASTLE LINER LLANDOVERY CASTLE

employed. The Ranchi and her sister ship, the Ranpura, were built by R. and W. Hawthorn, Leslie and Co., Ltd., whilst the Rawalpindi and the Rajputana were constructed by Harland and Wolff, Ltd., at Greenock and engined at Belfast. Of the "C" type of vessels the Cathay and Comorin were both built and engined by Barclay, Curle and Co., Ltd., at Glasgow. They are 545ft. ships with a gross tonnage of about 15,000 and are equipped with twin-screw quadruple-expansion steam engines working at a steam pressure of 220 lb. per square inch. The Chitral is a similar ship and she was launched and completed by Alexander Stephen and Son, Ltd., at Linthouse, Govan.

Another interesting liner of the year is the

Llandovery Castle, which was completed by Barclay, Curle and Co., Ltd., for the African service of the Union Castle Mail Steamship Company, Ltd. We illustrate this ship in Fig. 2. She has twin-screw quadruple-expansion reciprocating steam engines of 7000 indicated horse-power and is designed for a speed of about 16 knots. She is 470ft. long, with a gross register of 10,609 tons.

Another important large passenger liner built on the Clyde in 1925 was the Conte Biancamano, which was constructed by William Beardmore and Co., Ltd., of Dalmuir, for the Lloyd Sabaudo Company, of Genoa, and is illustrated in a Supplement to-day. She is the third ship of her type, the previous vessels being the Conte Rosso and the Conte Verde; but the new liner embodies several improvements in accommodation arrangement and propelling machinery. In our issues of November 13th and 20th we gave an account of this fine vessel and her double reduction geared turbines, which are the largest yet constructed for a mercantile vessel. The Conte Biancamano has an overall length of 655ft., with a breadth of 76ft., a depth of 39ft., and a measurement of about 23,000 gross tons. Her turbines are designed for a total of 24,000 shaft horse-power and 25,600 horse-power was developed on the trial run at Skelmorlie. The normal speed of the ship is 20 knots and steam is supplied to the turbines at 220 lb. pressure with 220 deg. Fah. superheat.

Two other liners built on the Clyde and delivered early in the year are the Canadian Pacific Railway Company's ships Princess Kathleen and Princess Marguerite. A view of the latter vessel as she appeared on her Clyde trials is reproduced in one of our Supplements to-day. These two ships were specially designed for day and night service on the triangular route between Vancouver, Victoria and Seattle. They are particularly well equipped as regards public rooms and cabin accommodation. They have a length of about 368ft. with 6000 gross tons register and the three funnels give them a particularly handsome and attractive appearance. Brown-Curtis single reduction geared turbine machinery of about 13,500 shaft horse-power is fitted. On the south side of the Clyde two other three-funnelled ships were delivered during the year. We refer to the Anchor-Cunard liners Transylvania and Caledonia, which were built and engined at the neighbouring yards of the Fairfield Shipbuilding Company, Ltd., and Alexander Stephen and Sons, Ltd., respectively. These ships have a length of 587ft. with a gross tonnage of about 16,800. The propelling machinery comprises twin-screw sets of double reduction geared turbine machinery fitted with the nodal drive. A service speed of about 17 knots is maintained. We illustrate the Caledonia in Fig. 3.

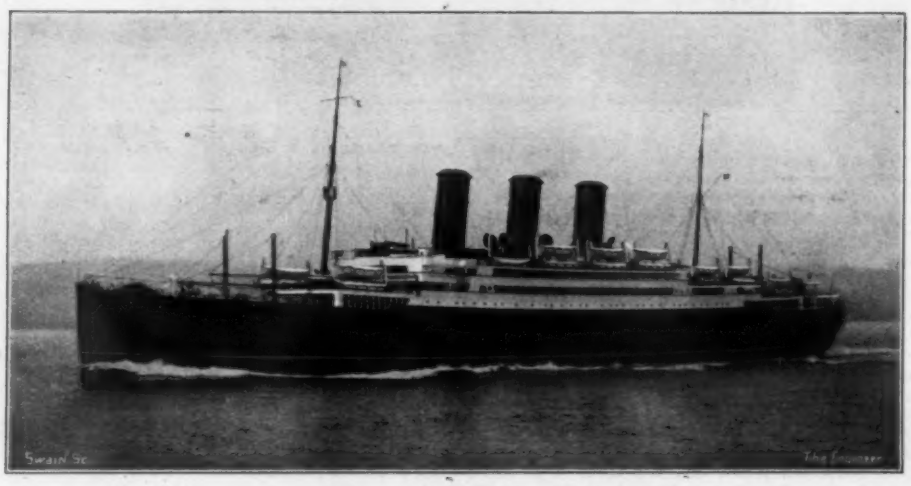


FIG. 3—CUNARD-ANCHOR LINER CALEDONIA

At Barrow Vickers Ltd. completed the Newfoundland, which was specially constructed for the North Atlantic passenger and cargo trade of the Warren Line. She is a 423ft. ship of 6820 gross tons, propelled by quadruple expansion balanced engines of 5560 indicated horse power running at a speed of 80 revolutions per minute.

Some Refrigerator Ships.

Several ships specially designed for the carrying of refrigerated cargo were launched and completed during 1925. At Cammell Laird's were built the steamships Aracataca, Carare, Casanare, Cristales and Sulaco for Elder and Fyffe's fruit trade. They are ships of from 5376 to 6878 gross tons, propelled by triple-expansion steam engines. Similar machinery was installed in the La Perla, a sister ship to the Diesel-electric vessel La Marea, completed last year for the United Fruit Company, of Boston. At Belfast Workman, Clark and Co., Ltd., built a single screw steamer Gatun for the Standard Fruit and Steamship Company's Central American traffic. In May inquiries were sent out for eight new refrigerator ships for the Blue Star Line, and orders were placed with British shipbuilders on tenders revised in the light of competitive prices from German and Dutch yards. These ships are to be built by Lithgow's, Ltd., Port Glasgow; Palmer's Shipbuilding and Iron Company, Ltd., Hebburn and Jarrow-on-Tyne; and Cammell Laird and Co., Ltd., of Birkenhead. They are to be equipped with special refrigerating machinery which will be steam driven. Twin-screw single reduction geared turbines of 5800 shaft horse-power will be employed. The ships will have a deadweight carrying capacity of about 12,000 tons.

Railway and River Boats.

William Denny and Bros., Ltd., of Dumbarton, completed two twin-screw geared turbine cross-Channel steamers of about 2650 gross tons, the Isle of Thanet and the Maid of Kent, for the Southern Railway Channel services, whilst a Clyde excursion steamer, the Glen Sannox, was finished for the L.M. and S. Railway. A small vessel propelled by vane wheels was completed for the China trade. At John Brown's Clydebank yard two cross-Channel steamers of 1885 gross tons each were launched and engined for the Great Western Railway's services; whilst new turbine machinery of 8000 shaft horse-power was supplied for the same owners' turbine steamer St. David. John Samuel White and Co., Ltd., of East Cowes, built to the order of the General Steam Navigation Company, Ltd., the 309ft., 18¼-knot paddle steamer Crested Eagle for service between London and Margate. The ship is propelled by triple-expansion diagonal paddle engines with cylinders of 30in., 46in., and 69½in. diameter, with a stroke of 66in., designed to work at a pressure of 160 lb. per square inch. At Birkenhead, Cammell Laird and Co., Ltd., completed several passenger and vehicular ferries for Mersey service.

Among somewhat special river vessels, we single out for mention the shallow-draught twin-screw steamer Fushun, which was built by Thornycroft's for the upper reaches of the Yangtse River in China; a description of her trials is included in the issue of THE ENGINEER for September 11th. A vessel of somewhat unusual interest is the Glenledi, built by Swan, Hunter and Wigham Richardson, Ltd., one of several vessels for the Canadian Lakes. She is a ship with a finished length of 379ft., designed to carry about 4825 tons on 18ft. fresh-water draught. In order to allow her to proceed through the Welland Canal, Ontario, some 144ft. of her length was omitted and was sent out in a fabricated condition, to be inserted after her arrival at the Lakes. The same builders, who during the year were among the busiest on the North-East Coast, completed seventeen steamships, representing close upon 98,900 tons. At Hull Earle's Shipbuilding and Engineering Company, Ltd., completed four lake boats, three tugs, and twelve barges.

Dredgers Built During 1925.

Although dredger building yards were not fully employed during the year, several vessels of this class, together with pontoons and harbour machinery, were furnished for at home and abroad. At Renfrew Lobnitz and Co., Ltd., built and tried the 1470-ton twin-screw self-propelling hopper bucket dredger Sir William Price, to the order of the South African Railways and Harbours Administration. Two smaller suction dredgers and a bucket dredger in addition to pumping plant and pontoons were completed. In the neighbouring yard of William Simons and Co., Ltd., a cable steamer for the Indian Government and the bucket hopper dredger Woodford for the Port of Spain, Trinidad, were built. This firm also supplied a twin-screw sludge steamer, the Dalmarnock, for the Glasgow Corporation Sewage Department. She is a 260ft. vessel with 1200 indicated horse-power engines and multitubular boilers. Ferguson Bros., Ltd., of Port-Glasgow, completed a bucket hopper dredger, David Davies II., and a grab hopper dredger for British owners, as well as a salvage steamer and tug.

Fleming and Ferguson, of Paisley, also built several ships, including a drag suction dredger for the Queensland Government. William Beardmore and Co., Ltd., have under construction a new sludge carrying steamer of 1500 tons carrying capacity for the London County Council.

Repairs and Reconditioning.

The reports from various centres show that, in spite of competition from the Continent, a good many orders were received and repairs carried out, a large amount of the work, of course, being provided by British shipping lines. At Belfast, Harland and Wolff altered and reconditioned the White Star ships Bardic, Vedic, and Delphic and overhauled several petroleum-carrying vessels and motor ships. The company reports that its engineering and repairing works at Liverpool and Southampton were kept busy throughout the year, whilst the volume of work at the Thames yard showed a steady increase. John I. Thornycroft, Ltd., of Southampton, dealt with thirty-three vessels, which were dry docked, and approximately two hundred other ships of various types passed through the firm's hands. Cammell Laird and Co., Ltd., of Birkenhead, carried out repairs to several large vessels, but they report that the repairing industry of the port of Liverpool was generally in a very depressed condition. Palmer's Shipbuilding and Iron Company, Ltd., of Hebburn and Jarrow, docked and repaired sixty-nine vessels during the year, amongst them being the steamship Chios, which was converted from a cargo vessel into a floating workshop for the use of the Greek Navy. A fair amount of repair work was done at the various yards on the Clyde.

Salvage Operations and Shipbreaking.

Although many proposals were put forward at different periods of the year advocating the scrapping of obsolete ships with a view to their replacement by more modern tonnage, the main shipbuilding work and salvage operations of the year were associated with naval vessels. The Scapa Flow operations carried out by Cox and Danks, Ltd., of Regent-street, London, in connection with the raising of the scuttled German fleet were most successful and twenty destroyers were raised and later dismantled. In our issue of September 4th we described and illustrated a new lifting dock which was made by Cox and Danks, Ltd., from one of the centre sections of the large ex-German floating dock acquired by the firm for breaking up purposes. It is to be used in lifting the seven 320ft. destroyers. When this work has been completed operations will be begun early in the spring with a view to raising the battleships Hindenburg and Seydlitz.

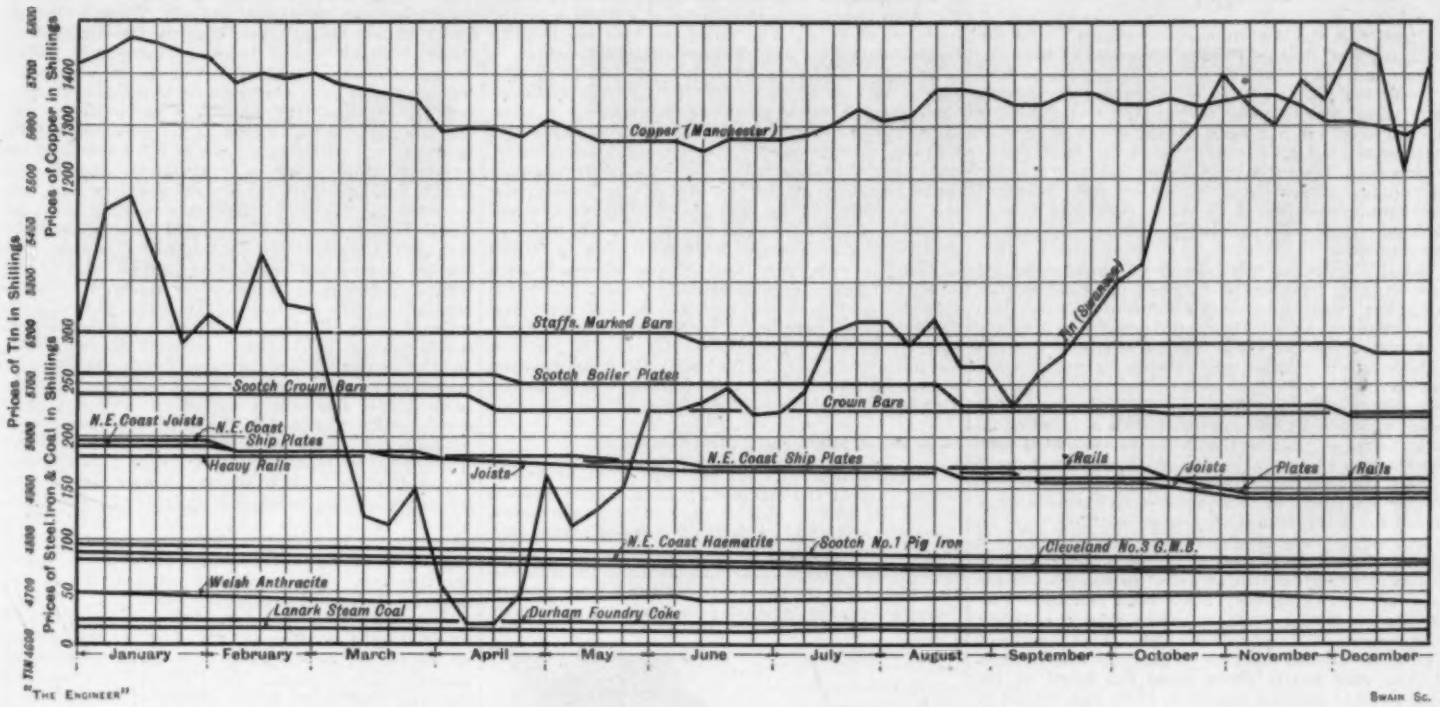
Some New Developments.

In September considerable interest was created by the announcement that Turbine Steamers, Ltd., of Glasgow, had placed an order with William Denny and Brothers, Ltd., of Dumbarton, and the Parsons Marine Steam Turbine Company, Ltd., of Wallsend-on-Tyne, for a 250ft. twin-screw Clyde steamer which will be propelled by 500 lb. pressure steam turbine machinery. The turbines will be designed to work with steam at a pressure of 500 lb. to 550 lb. per square inch and a temperature of 700 deg. to 750 deg. Fah. Yarrow water-tube boilers with the latest pattern of preheaters are to be installed. Steam will be tapped from the turbines for feed heating and all the most recent improvements in steam turbine practice will be applied to this installation. Good progress has been made by Yarrows Ltd. with the two boilers, each of about 4000 square feet heating surface, the steam drums for which were rolled by John Brown and Co., Ltd. It is an interesting fact that, owing to the high pressure, the main steam pipe from each of the boilers will be only 3in. in diameter. The installation should serve to demonstrate the claim made by Sir John Biles in his paper read before the Institution of Naval Architects' spring meetings that with higher steam pressures and stage feed heating, an overall thermal efficiency not far short of that obtained with Diesel oil engines should be obtained in practice. The trials of this pioneer ship, which should be completed in May, will be awaited with considerable interest.

Another interesting turbine ship is one to be built in America for the International Marine Company of New York, by the Newport News Dry Dock Company. She will be a 20,000-ton, 18-knot ship, propelled by motors supplied with current from large turbo-electric sets. The machinery will be supplied by the General Electric Company, Ltd., of Schenectady, and some interesting results as regards efficiency will probably be obtained.

An interesting event of the year to which passing reference may be made is the proposal put forward by Mr. John De Meo, an Italian naval architect, that, with the object of dispensing with tunnels, obviating vibration, racing, and improving ship form, the propellers should be placed in recesses formed in the hull amidships Experimental tests were carried out upon models in the Spezia tank, with very promising results, and we are informed that Dr. Gebers is to continue these experiments in the Vienna tank. The outcome will be watched with much interest by marine engineers and naval architects.

FLUCTUATIONS IN THE PRICES OF ENGINEERING MATERIALS DURING 1925



The prices are all given in shillings. It should be noted that separate zeros are given for tin and copper, while the scales for these two metals are different from those for other commodities. All the scales are, however, the same as those of our graph for 1925, so that the two can be compared. The divisions of the horizontal base line represent weeks, taken from Jan. 2nd to Dec. 25th. In the case of coals the prices are those quoted for export, as it is practically impossible to give market prices for industrial consumption at home. Thus in South Wales the prices for inland consumption are sometimes 2s. per ton above, and at other times as much below, export prices. In Scotland the pithead price is generally some 2s. below the f.o.b. price, but carriage costs from 4s. to 7s. 6d., according to the distance. In the Midlands home prices are generally from 2s. 6d. to 4s. per ton less than those for export.

SIXTY YEARS AGO.

WITH to-day's issue THE ENGINEER enters upon the seventy-first year of its existence. Sixty years ago, in our issue of December 29th, 1865, on the completion of the journal's tenth year, a brief statement was published regarding the position which it had attained and the proprietors' intentions for its future development. THE ENGINEER, it was stated, had proved more successful than had ever been anticipated, and had attained a position unrivalled in the history of the scientific Press. Nevertheless, much, it was recognised, remained to be accomplished, for the journal still fell far short of that approach to the standard of completeness which the proprietors had set before themselves. Within the previous fourteen or fifteen months, the announcement continued, the character of the journal had been improved in a gratifying manner under "the new and conscientious editorial management" that had been instituted, a reference to the assumption of the editorial chair by the late Mr. Vaughan Pendred in the place of Mr. Zerah Colburn. As to the future, it was intimated that increased attention would be paid to civil engineering, shipbuilding, and other branches of the industry which owing to circumstances, rather than intention, had been inadequately represented in our columns. It was also announced that the cordial co-operation had been secured of several of the most eminent scientific authorities of the age, who would supply original matter of a class such as had never previously appeared in the columns of a weekly journal. There was considerable room, it was felt, for improvement in the matter of illustrations, both as regarded subject matter and quality. It was intended that "engravings of the best examples of actually executed and tried machinery as constructed by eminent firms" should replace much of the illustrated matter previously inserted in the journal. Up to that date, it may be explained, we had relied very largely for our illustrations upon the drawings accompanying recently issued patent specifications. Under the new scheme, the policy was instituted—a policy still in force—of excluding the description of mere proposals and untried inventions from the general body of the paper. As for the quality of the engravings, it may be remarked that the days of the woodcut, on which sole reliance was placed, were even then numbered. It is true that another twenty years or so were to elapse before half-tone engravings made by a photographic process began to appear at rare intervals in our columns, but in the very issue from which we have quoted the coming of that process was forecast and clearly recognised for what it would mean in the way of book and newspaper illustration. In an article, entitled "A Revolution in Wood Engraving," we gave details of several processes tried since 1860 for the production of engravings otherwise than on wood. Hitchcock's graphotype process did not involve photography, but it was so simple and rapid that it appeared "that it must be the forerunner of a daily illustrated paper." The Woodbury and the Swan processes were both of a photographic character, but, of course, neither employed the screen which is the foundation of the modern half-tone process. The wood engravers had, we find it written, brought their art to a very creditable state of excellence, but the new processes, especially Mr. Swan's, threatened to overwhelm them. It was hoped that the engravers would treat the new processes as friends and not as foes, and that the innovations would represent not a loss to the engravers, but a gain to the public.

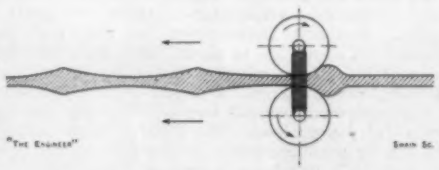
Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ROAD CORRUGATIONS.

SIR,—The excellent paper read before the recent Roads and Transport Congress by Mr. E. L. Leeming, Assoc. M. Inst. C.E., and noticed in your issue dated the 4th inst., makes a material contribution to our knowledge of this subject; yet I venture to suggest that it could be made more instructive if considered from another point of view.

About two years ago I commenced research on "The Origin and Growth of Ripple Mark," with particular reference to its occurrence in sand, under oscillating water, and in estuarial models constructed in accordance with the principles laid down by Professor Osborne Reynolds in 1887—*vide* British Association report. The results of my experiments with (*a*) fluids of different viscosities, (*b*) elastic solids, (*c*) granular materials, (*d*) flocculent substances, are not yet sufficiently complete and conclusive for communication, but I am confident of being able to establish, ultimately, the association of "road corrugation" with ripple mark. In my draft notes I have defined ripple mark as: "The mark resembling a series of ridges and furrows, which, occurring in viscous, elastic or mobile materials, owes its origin to the frictional effects of relative motion, and grows or develops in proportion to the capacity of the (passive) material to assume an equilibrating change of surface configuration. The ridges



may be spaced regularly or irregularly, and they may be symmetrical or otherwise, but wave lengths and amplitudes invariably occur in terms of velocity, density and viscosity (and in fluids, of surface tension). There are three kinds of ripple mark. The first is produced (contrary to the conclusions of Sir George Darwin and Mrs. Hertha Ayrton) by steady motion in one direction. The second is due to periodic oscillating motion; and the third to irregular oscillating motion. The most striking characteristic of ripple mark is the uniformity of pattern in any given example, suggesting at once law and order, a given series of active agents producing inevitably a perfectly orderly set of results in the passive medium. Modify the operating conditions ever so slightly, and such modification is reflected in the mark."

"Road corrugations," *vis-à-vis* ripple mark, may be better understood in the light of the following imaginary simile:—Imagine a strip of, say, india-rubber being passed between two rollers, the rollers being kept in partnership by means of a spring connection, as shown. It is easy to see that the compression imposed upon the moving strip will result in a piling up, as shown, behind the rollers, and that such piling up will continue until the energy stored in the blob equals that contained in the spring. A small increment in the rubber will then force the rollers apart and the blob will jump through.

Thereafter, the strip will pass along until, in a definite length, another blob will be formed, and, could the rubber maintain its modified form, it would show a perfectly orderly series of ridges and furrows. Replace the lower roller by a strip of india-rubber mounted upon a level bed of a much less elastic material, and the identity of "road corrugations" should not be difficult to comprehend.

ALFRED WEALE.

Heswall, Ches., December 23rd.

BRITISH LOCOMOTIVES, 1825–1924: No. XLII.

SIR,—I am sure that in the interests of accuracy and general interest Mr. Ahrons will not resent the following notes.

4–4–4 T *Locomotives.*—There were three of this type on the Wirral Railway, No. 11 built in 1896 and Nos. 14–15 built about 1903. These latter had G.C.R. type chimneys, &c., and gave rise to a rumour that the Wirral was to be absorbed by the former line.

Buenos Aires Western Railway.—All the twenty-four locomotives of this type were built by Beyer, Peacock and Co., Ltd. There are also twenty-four of a slightly larger design on the Buenos Aires and Pacific Railway, which are now in process of conversion to the 2–6–4 T type with superheaters. Mr. Sedgefield introduced this type on the Central Uruguay in 1913, in which year six engines were built. Two superheated examples were added in 1906. The type is also to be found on the Donegal Railway and on the Burmese Railways, and has more recently been introduced on the metre-gauge track of the B.B.C.I. Railway.

2–4–2 T *Compound, B.C.D. Railway.*—These engines were at some later date provided with leading bogies, having outside frames, and are running in this condition at present. The same procedure was followed with the two 7ft. 4–4–0 Jubilee and Parkmount on the B.N.C. Railways, and with the two earlier "D" class—now "F"—compounds of the N.E.R. There are some half-dozen compound tanks of this wheel arrangement on the narrow-gauge section of the B. and N.G. section of the old Midland Railway, all built by Beyer, Peacock and Co., who have also supplied compound passenger tanks of the 4–4–2 and 4–6–2 wheel arrangement to the Central Argentine Railway. Kitson and Co. have also provided this railway with 4–4–2 compound tanks.

2–6–0 T.—There was also one engine of this wheel arrangement on the Garstang and Knott End Railway, built by Manning, Wardle. In South America the type is in use on the Central Uruguay and Monte Video Northern Railways, and existed at one time on the Central Argentine. It was also to be found on one of the Irish light railways connecting with the Cork, Bandon and South Coast Railway, and on both the narrow-gauge section of the N.C.C. and the Tralee and Dingle Light Railway. The Port Talbot "Americans" were of the 0–8–2 T type, not 0–8–0. A sister engine of the Wrexham Mold and Connah's Quay Railway 2–6–0 T was rebuilt as a 0–8–0 saddle tank, with domeless boiler, and is still in service of the G.C. section of the L.N.E.R. The 0–8–2 T engines of the Barry Railway were built as tank engines; editions of the old 0–8–0 tender engines of the same line. Boiler, cylinders, wheels and motion were duplicate with these latter.

JOHN POOLE.

Liniers, Buenos Aires,
November 18th, 1925.

Aeronautics in 1925.

No. I.

ALTHOUGH the Air Ministry continued to be the chief support of the British aeronautical industry during the past year, there was a fair measure of activity on orders placed by foreign Governments and other overseas customers. On the whole, if the industry was not exactly prosperous, it at least experienced no worse trade than other branches of engineering. The output was confined in large measure to military machines, neither commercial machines nor light aeroplanes of the class produced in considerable numbers in 1924 figuring prominently in the returns.

On the technical side, the developments effected were of very considerable interest, the chief feature being the greatly increased attention paid to metal construction. As regards the progress made in power and speed, the facts and figures available are not sufficient to enable an exact statement to be made, but some idea of what was achieved may be gained from the fact that in this country a two-seater day bombing machine was produced with a speed equal to and even surpassing that hitherto associated with single-seater fighting scouts. Of machines built purely for racing purposes, one, the Supermarine-Napier S 4, achieved in September an official world's record for a seaplane with a speed of 226¾ miles an hour. This machine met with a run of ill-luck in America, in connection with the Schneider Cup race, but even though it had survived to compete in the race it would doubtlessly have been vanquished by the Curtiss racing machine, which won the contest with a speed of 232¼ miles an hour. That speed was no mere fractional advance on previous attainments. It was very nearly three times the speed of the machine that won the contest in 1920, and showed an increase of 55 miles an hour over the speed of the winning machine of 1923.

Close attention continued to be paid to the control of aeroplanes at low speeds. That the problem of stalled flight has now definitely emerged from the experimental stage was demonstrated at Croydon Aerodrome in April by a Fokker and an Avro machine. These two machines, the first a monoplane of 450 horse-power and the second a biplane with an engine of 100 horse-power, represented two different methods of attacking the problem. The Dutch aeroplane was equipped with enlarged wings and lateral control surfaces, while the British was fitted with Mr. Handley Page's slotted wings. Both succeeded in giving a remarkable display of controllability at speeds below the stalling value. The Fokker monoplane, with ten people on board, was shown to be capable of retaining an even keel after the stalling condition was reached. The Avro was demonstrated to be under complete control at 27 miles an hour, although its normal stalling speed is about 38.

Civil Aviation.

Judged by the number of passengers carried on the services between this country and the Continent, it would appear that civil aviation as a means of travel is making sure but distinctly slow progress. Operating costs are, however, still very high, and even the Director of Civil Aviation at the Air Ministry has had to admit that ten times the present traffic would be required before air transport could be made to pay its way. British air services of a regular character are still rendered possible only by generous assistance from the Government. It would appear, however, that the subsidy agreement with Imperial Airways, Ltd., has not fulfilled all its intended objects. A feature of that agreement is the stipulation that the machines of the company shall fly at least 800,000 miles in each of the first four years, and at least 1,000,000 miles a year thereafter. On March 31st the company completed the first year of its existence, and during that period its machines flew some 828,000 miles. To fulfil its obligations, the company was naturally inclined to run a large number of small machines rather than a smaller number of larger machines of equivalent capacity. In order to encourage the employment of the second-named type, the operation of which is recognised to lead to economy and efficiency, a new agreement is being executed, which will substitute 425 million horse-power miles per annum for the original requirement of 1,000,000 miles. Such an agreement will clearly put a premium on the use of high-powered machines.

The subsidised services operated with regularity and without major accidents. Plans were devised for their considerable extension, and an agreement is now being negotiated for the institution of a regular fortnightly service between Egypt and India for passengers, mails and freight. This service, it is anticipated, will be in operation towards the end of this year. An interesting feature of the agreement is that the use of three-engined machines is specified as a condition to be observed. A survey of the route to be followed—namely, *viâ* Baghdad and Basra—showed that the unfrequented nature of much of the ground passed over rendered it essential that all possible steps should be taken to avoid forced landings. The construction of triple-engined machines received additional encouragement during the year from the commendation of it by the Aeronautical Research Committee as a means of ensuring regularity of service. Apart from the Egypt-India route, Imperial Airways, Ltd., is credited with the intention of developing a service between Egypt and Cape Town. Mr. Alan Cobham, in the course of a flight over the route, which he began on November 16th, incidentally undertook to survey it for the company's benefit.

Although civil aviation is still far from being self-supporting, it is, nevertheless, true that technical developments have resulted in rendering it considerably less costly than it was a few years ago. In 1919, when it was first permitted in this country, it was generally accepted that the cost of air transport could be taken at 10s. per ton-mile. To-day, the cost, according to the latest available figures, works out at 4s. 6d. per ton-mile at a speed of 95 miles an hour. With a passenger machine loaded to 60 per cent. of its capacity, the cost per passenger with 40 lb. of luggage is given at 8d. per mile. Towards this cheapening of the cost engine and structural developments have contributed a material share. During the war and immediately after it our best machines could only fly for about 250 hours between overhauls. To-day the cross-Channel aeroplanes fly for 1500 to 2000 hours without overhaul.

Some British Military and Civil Aeroplanes.

Following our custom of previous years, we review below some of the machines produced or completed during the year by British aeroplane manufacturers. As usual, official restrictions prevent our saying anything about certain of the machines turned out in the period under review, while in other cases the information which it is permissible to publish is very meagre. Nevertheless, the accounts presented are, we believe, sufficiently full to give a fair idea of the different directions in which progress is being made.

AVRO-LYNX SEAPLANE

Handley Page, Ltd.—The only commercial machine delivered during the year by Handley Page, Ltd., of Cricklewood, N.W. 2, was a three-engined biplane, built for Imperial Airways, Ltd. This aeroplane, the "Hampstead," is illustrated in one of our Supplements to-day. In many respects it repeats the design of the triple-engined "Hamilton" machine, illustrated and described in our review of aeronautics a year ago. Of chief interest in the changes made is the replacement of the three water-cooled engines formerly fitted by three air-cooled Armstrong-Siddeley "Jaguar" engines. The total horse-power has thus been increased from about 820 to about 1200, and a possible source of breakdown inherent in the employment of radiators, water pumps, &c., has been eliminated. In addition, extra weight has been set free for the carriage of paying load. The number of passengers that can be accommodated in addition to the pilot and navigator has been increased from twelve to fourteen, and the weight of luggage, &c., from 630 lb. to 1150 lb. The maximum speed, too, has been raised from 105 miles an hour to 116, the landing speed remaining at the low figure of 45 miles an hour. The machine can not only fly on any two engines, but actually take off and climb at the rate of 200ft. per minute with one engine out of action. It is claimed to be the first three-engined machine that has actually climbed with only two engines in action. With only one engine running, the machine descends at a rate of 200ft. per minute, and at a gliding angle of about 1 in 20. The trials during which these figures were obtained were conducted with the full load on board the machine.

At the Cricklewood works four twin-engined machines, each capable of carrying fourteen passengers and a crew of two, are now under construction for Imperial Airways. The engines of these machines will be Napier "Lions." Another very interesting machine is being built by the firm, namely, a triple-engined commercial monoplane, seated for six or eight passengers. The engines in this case will be Bristol "Lucifers" of 120 horse-power each.

Westland Aircraft Works.—In addition to reconditioning and rebuilding a number of DH 9 A machines, the Westland Aircraft Works (Petters Ltd.), Yeovil, designed and built for the Air Ministry three "Yeovil" day bombing aeroplanes. This design of machine—illustrated in the Supplement—was produced to secure certain important features requisite in a day bomber, and, in particular, to give the observer a good uninterrupted view downwards, in order to enable him to use to full advantage the accurate bomb sights now available, and also to obtain a high degree of positive stability and very steady flying in order to facilitate accurate shooting. These features, it is claimed, have been specially attended to in the "Yeovil" bomber. The observer's cockpit is situated behind the trailing edge of the wings, and permits a clear view downwards to be obtained over a large area. To improve the pilot's forward view, the fuselage decking is sloped downwards towards the engine. Ailerons are fitted only to the top planes, but they are of large area and are stated to give very effective and light control. On each side of the centre section the upper wing is considerably thickened in the form of a wing section of high lift characteristic. The petrol tanks are housed inside these thickened portions. The petrol supply from the tanks to the engine is effected entirely by gravity. The undercarriage, it will be noted, has a wide track, and is equipped with "oleo" shock absorbers. A Rolls-Royce 650 horse-power "Condor" engine, fitted with a two-bladed metal screw, drives the machine. The armament consists of one gun firing forward and two guns firing aft.

A. V. Roe and Co., Ltd.—The year was mainly devoted by A. V. Roe and Co., Ltd., of Manchester, to the farther development of machine types introduced in former years. The "Bison" fleet-spotting machine dealt with in our review of aeronautics in 1922 was subjected to careful and systematic modification and was brought to the fully developed stage. A considerable number of machines of this design was supplied to the Air Force for use by the section co-operating with the Fleet. The latest form assumed by the design is illustrated in the Supplement. The machine is intended for naval gunnery spotting duties, and is capable of alighting on a ship's deck at a low speed. It is fitted with folding wings, and is constructed very largely of steel. The crew carried numbers four, namely, a pilot, a wireless operator, an observer, and a gunner. Details of the construction or performance cannot be published, but it is noteworthy that in the latest form the upper wings are raised above the top of the fuselage, and that the pilot's cockpit has been considerably lowered from its earlier position just in front of and in line with the upper wings. The machine, we learn, is now about to be developed as a torpedo carrier, which can be arranged either as a seaplane or a landplane.

The well-known "Avro" training machine was modified in two directions. As a landplane it was fitted with an Armstrong-Siddeley "Lynx" engine of 180 brake horse-power, in which form it was supplied to several foreign purchasers and to the Air Ministry for use at the Central Flying School at Upavon. Like the earlier 504 K type, the machine has dual control throughout, even to the adjustment of the tail plane. The centre section and the wing roots have been modified in such a way as to improve the forward and upward vision of both the pilot and the pupil. With the "Lynx" radial air-cooled engine substituted for the rotary engine of the earlier design, an economy of fuel, it is stated, has been secured, the consumption at full power being about 12 gallons an hour. Moreover, a satisfactory cruising speed can be obtained at about quarter throttle, with a petrol consumption of not more than 7 gallons an hour.

The second development of the original 504 K type is practically identical with the "Lynx" training land plane, except that it is fitted with two mahogany double-skinned floats, to suit seaplane training purposes. We illustrate the nose end of this machine herewith. As an alternative, the machine may be fitted with a single central float and two wing tip floats. In either form no tail float is required.

The firm undertook no further work on light aeroplanes, the "Avis" machine fitted with a Bristol Cherub engine as constructed for the 1924 competitions continuing to be used with success. A very large aeroplane for the Air Ministry is now nearing completion in Messrs. Roe's works, but no details of its design can be given.

Vickers Ltd.—The Weybridge works of Vickers Ltd. was largely employed during the year on the production of machines either of types described in preceding years or on modifications of those types. A notable machine completed within the twelve months was a twenty-five-seater passenger aeroplane of the "Vanguard" design, the prototype of which was illustrated in our issue of January 11th, 1924. This machine—illustrated in the Supplement—was built to the order of the Air Ministry, and is now in the service of Imperial Airways, Ltd. The most important modification in the design is the increase in power that has been effected by the installation of two Rolls-Royce "Condor" engines of 650 horse-power each, in place of two of 450 horse-power, used in the earlier form. From the view of one of the

engines reproduced herewith, it will be noted that the propellers are now four-bladed instead of two bladed, and that the radiator equipment has been entirely rearranged. The radiator, instead of being of the ordinary type, situated below the engine, has been moved upwards and is now partially embodied in the upper wing. It is of the Anderton-Brown

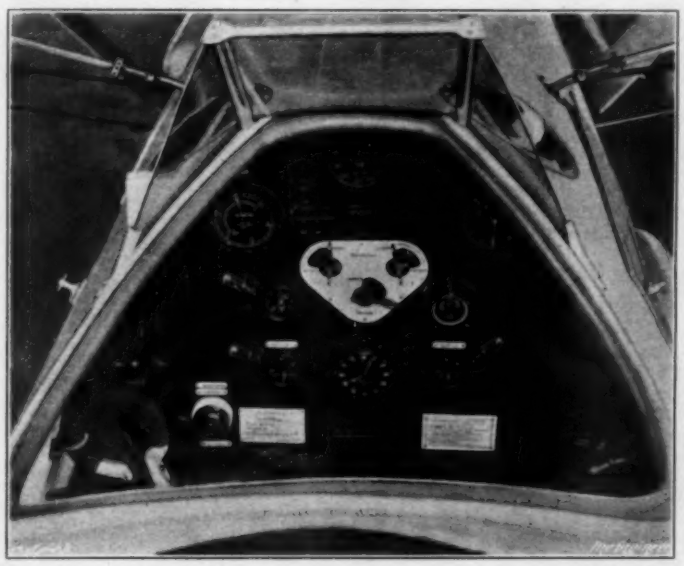
CONDOR ENGINE ON VICKERS "VANGUARD"

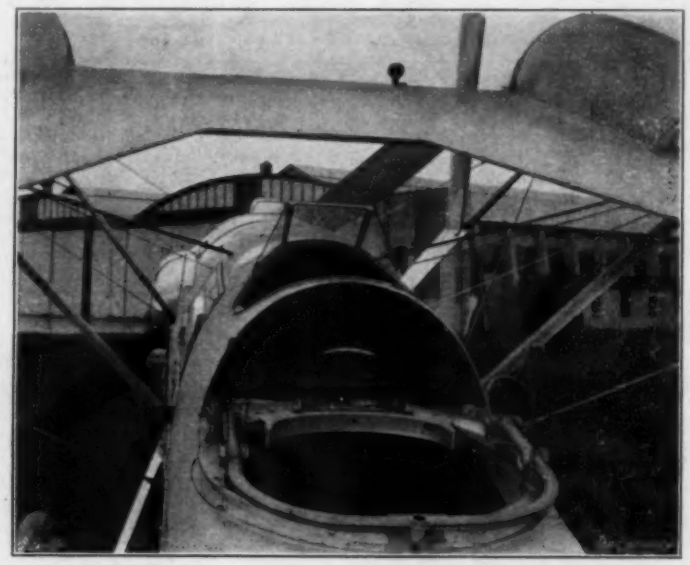
long-tube type. The machine in the new form has a maximum speed of 113 miles an hour, and a minimum speed of 49. It can climb to 10,000ft. in 23½ minutes. When fully laden it weighs about 8¼ tons. An interior view of the passengers' cabin is reproduced herewith. It is of interest to record that in October the machine was used to entertain a full complement of passengers to luncheon in the air. A week or so later it was employed by the British Broadcasting Company for the purpose of giving a wireless concert from the air. On this occasion the machine, in addition to the artists, carried an orchestra and a piano.

Government. It is a two-seater machine intended for fighting, photographing, reconnaissance and bombing, and is driven by a Napier "Lion" engine. Its maximum speed is 136 miles an hour, and its minimum 51, and it can climb to 10,000ft. in sixteen minutes. A view of the machine is given in the Supplement, while herewith we reproduce two photographs of the pilot's and the gunner's cockpits, the former being of especial interest as an indication of the instrument equipment now found necessary in an up-to-date aeroplane. The "Vixen" machine is now undergoing flight trials in the form of a float seaplane, the "Vendace," intended for training purposes, and to be fitted with a Rolls-Royce "Falcon" engine.

PASSENGERS' CABIN OF VICKERS "VANGUARD"

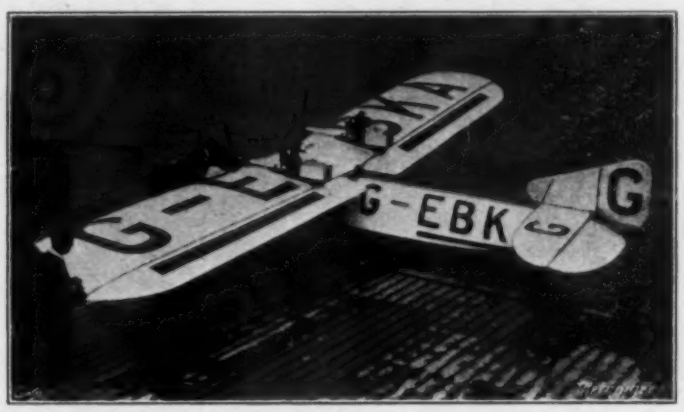
Short Brothers, Ltd.—During the year Short Brothers (Rochester and Bedford), Ltd., developed to an interesting extent their all-metal system of aircraft construction. The opinions we expressed regarding the firm's first all-metal machine, the "Silver Streak," on the occasion of its exhibition at Olympia in July, 1920, have, Messrs. Short inform us, been fully justified by the results of further experience with the system of construction adopted in it. Although





VICKERS "VIXEN" MILITARY MACHINE—PILOT'S AND GUNNER'S COCKPITS

The "Vixen V" represents a development of the Vickers "Valparaiso," which was also illustrated in our issue of January 11th, 1924. During the year it was the subject of a large contract for a foreign seaplane. In addition to constructing examples of the "Virginia" night bomber and the "Victoria" troop carrier, Messrs. Vickers were engaged upon the early stages of construction of a two-seater float



SHORT BROTHERS' 32 H.P. ALL-METAL MONOPLANE FLYING BOAT

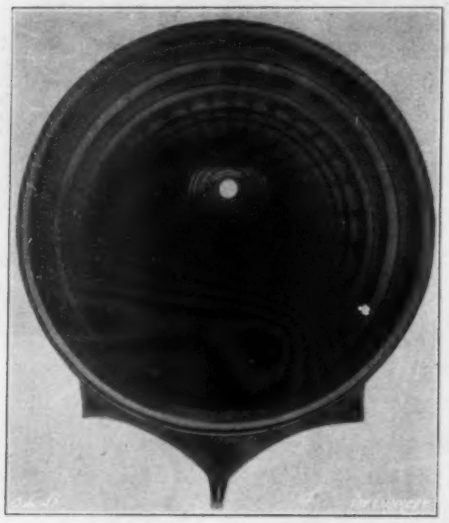
the application of that system to the construction of service machines was at first slow, the Air Ministry during the past year began to afford the firm a large measure of support in connection with it. In 1919,

when Messrs. Short began their work on metal machines, the use of light aluminium alloys in aeroplane construction was not permitted, except for some very minor details. The proposal to construct a machine almost entirely of such an alloy was regarded as very daring, at any rate, in this country. To-day, however, thanks very largely to Messrs. Short's pioneer work, all opposition has been withdrawn, and aluminium alloys are now being largely used by many British, American, and continental aeroplane manufacturers.

Recent work in this direction at Messrs. Short's factory has centred round the design and construction of metal hulls for flying boats and metal floats for seaplanes. The firm's first all-metal flying boat, the first of its class to be built in Great Britain, was remarkable because of the small power of its engines.

SHORT BROTHERS' DURALUMIN FLYING BOAT HULL

With two "Blackburn" motor cycle type engines, developing a maximum of 16 horse-power each, this machine is probably the lowest powered marine aircraft so far constructed. As shown in the accompanying engravings, it is a single-seater monopolane. It is built entirely of duralumin, except as regards the wing covering, which is of linen. With four hours' fuel on board, the machine has a total weight of 1400 lb., so that the loading per horse-power reaches the very high figure of 44 lb. At the same time, the loading of the main planes is low, being only just over 5 lb. per square foot. The propellers are 3ft. 9in. in diameter, and run at engine speed, namely, 3000 revolutions per minute. A high propeller speed, combined with a low horse-power, leads, as is well known, to a considerable loss of thrust efficiency. Nevertheless, the machine on trial developed a top



METAL HULL, LOOKING FORWARD

speed of 65 miles an hour. This machine, known as the "Cockle," was launched in September, 1924, and has now been taken over by the Air Ministry for experimental purposes.

Early in 1924 the firm received an order from the Air Ministry for an experimental all-metal hull to be fitted with its standard F 5 flying boat superstructure. The machine was completed in eight months, and has now been in service for a year, during which time it has, we learn, successfully withstood very severe service usage. An illustration of this machine appears in the Supplement, and in some of the engravings herewith we show the details of the firm's patented hull construction. It will be gathered that the bottom of the hull is formed with flutes running parallel with the direction of motion. These flutes are claimed to give the hull great rigidity and to prevent the under-surface "panting" when the machine is running on the water. In resisting water pressure, the flutes give rise only to tensional stresses in the metal, and as a consequence much lighter sheeting can be used than would otherwise be required. In addition, the fluting simplifies the internal structure of the hull by rendering it possible to dispense with interior stiffeners.

It is estimated by the firm that its system of metal construction saves about 25 per cent. of the weight of a wooden hull. In addition, there is a saving of weight arising from the fact that a metal hull does not soak up water. A wooden hull, after being in service for a few weeks, may absorb as much as 600 lb. of water. Allowing for this absorption, a metal hull, the firm states, would, under service conditions, have only two-thirds the weight of a wooden hull of the same size. Some very large all-metal flying boats are now being built by Messrs. Short for the Air Ministry, and it is estimated that the saving of structural weight that will be effected as compared with similar machines built in wood will be equivalent to an extra petrol-carrying capacity sufficient to extend the flying range by 300 miles.

The English Electric Company, Ltd.—In our review a year ago we mentioned that the English Electric Company, Ltd., of Preston, was devoting attention to the use of duralumin for the hulls of flying boats, and that the susceptibility of that material to corrosion in sea water and to electrolytic action had, it was believed, been overcome by means of a protective varnish and by avoiding the contact of dissimilar metals. These experiments resulted during the past year in the production of a twin-engined flying boat with a duralumin hull. This machine, of which we give an illustration in the Supplement, has, we are informed, been tested with very satisfactory results.

METAL HULL, LOOKING AFT

The superstructure of this machine is, we believe, identical with that of the company's "Kingston" flying boat, a machine having a span of 85ft. 6in. and driven by two Napier "Lion" engines. The "Kingston" type is fitted with a hull of double skin mahogany, the interior of which is free from bracing. Of that type the company completed, tested and delivered a number during the year. While it is not permissible to publish details concerning the machine illustrated in the Supplement or of its prototype, attention may be directed to the trolley on which the boat shown in our engraving is mounted. This launching trolley is the outcome of the firm's ten years' experience in the handling of marine aircraft. Its construction is low and enables the machine to be launched or brought ashore with a small depth of water. The sub-frame is mounted on springs to eliminate shocks and damage to the hull when rough ground is being traversed. The wheels are of large diameter, and are fitted with heavy solid rubber tires. The two pairs of wheels can be steered through a range of 180 deg., and therefore ensure a very complete degree of manœuvrability to the trolley. It is not a matter of minor importance to devise a satisfactory launching trolley. In the early days the development of the flying boat was seriously affected by the difficulty experienced in taking the machine from its shed to the water, and still more in returning it from the water to the shed.

Obituary.

SAMUEL BOSWELL.

BY the death of Mr. Samuel Boswell last Saturday, 26th ult., a very popular figure in Manchester engineering circles has been removed. Mr. Boswell had reached the age of seventy-six, and had been active until quite recently. He was for some years very prominent in connection with the affairs of the Manchester Association of Engineers, of which Society he was ex-president and a member of Council. He took part in debates very frequently, especially on the subjects of the steam engine and boiler, and generally had something of practical interest to contribute, for there were few men who were more familiar with the construction, operation and capabilities of the Lancashire and Galloway steam generators than he. For a period of about forty years Mr. Boswell was on the staff of Galloways, and prior to that he was employed as an inspector by the Manchester Steam Users' Association. He was elected a member of the Institution of Mechanical Engineers in 1891.

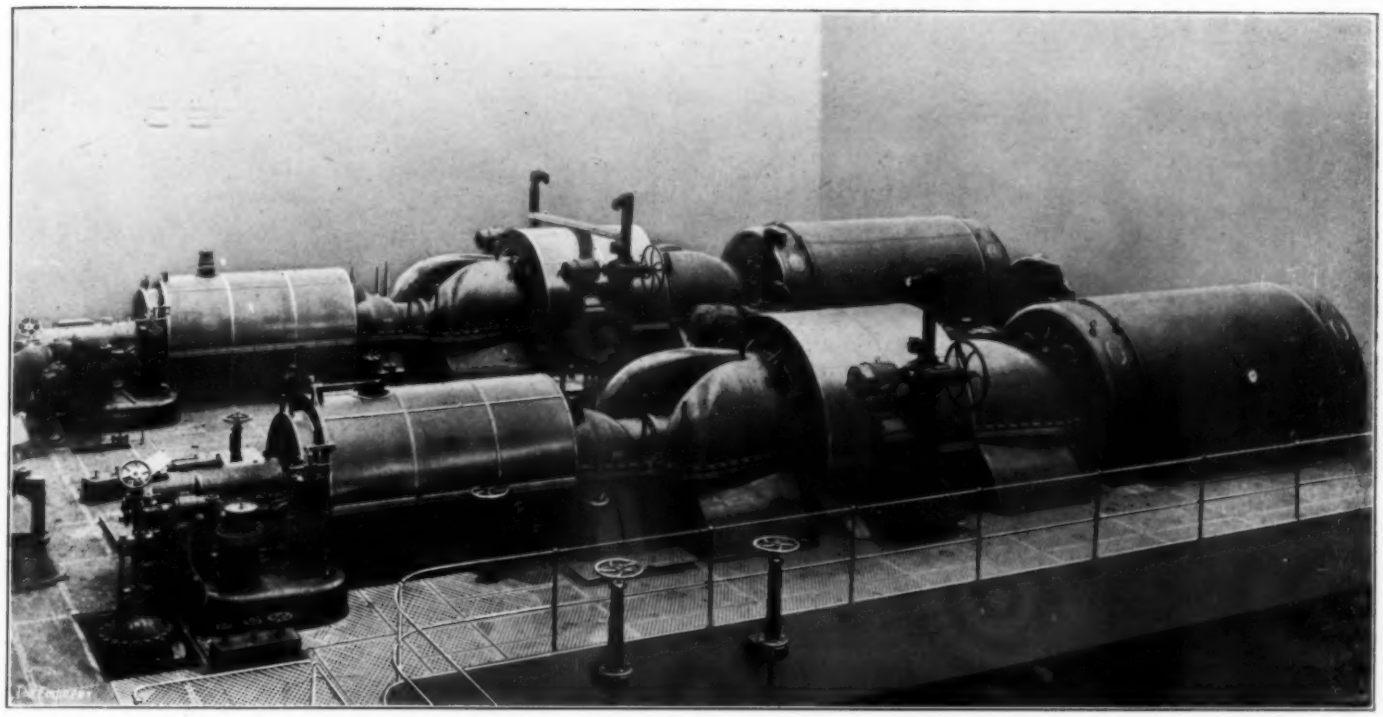
CECIL STANLEY WINDSOR.

THE death took place on December 18th of Mr. Cecil Stanley Windsor, of "Harewood," Slough, joint managing director of James Bartle and Co., Ltd., of Lancaster-road, Notting Hill, London, motor car body builders and makers of the Windsor car, which was named after him. Mr. Windsor was an active member of the S.M.M.T. and of the R.A.C., a member of the Institution of Automobile Engineers, and several other business and professional bodies. He had for some years been a well-known figure in the motor industry, and was the owner of numerous patents used in the motor, body building, and accessories businesses.

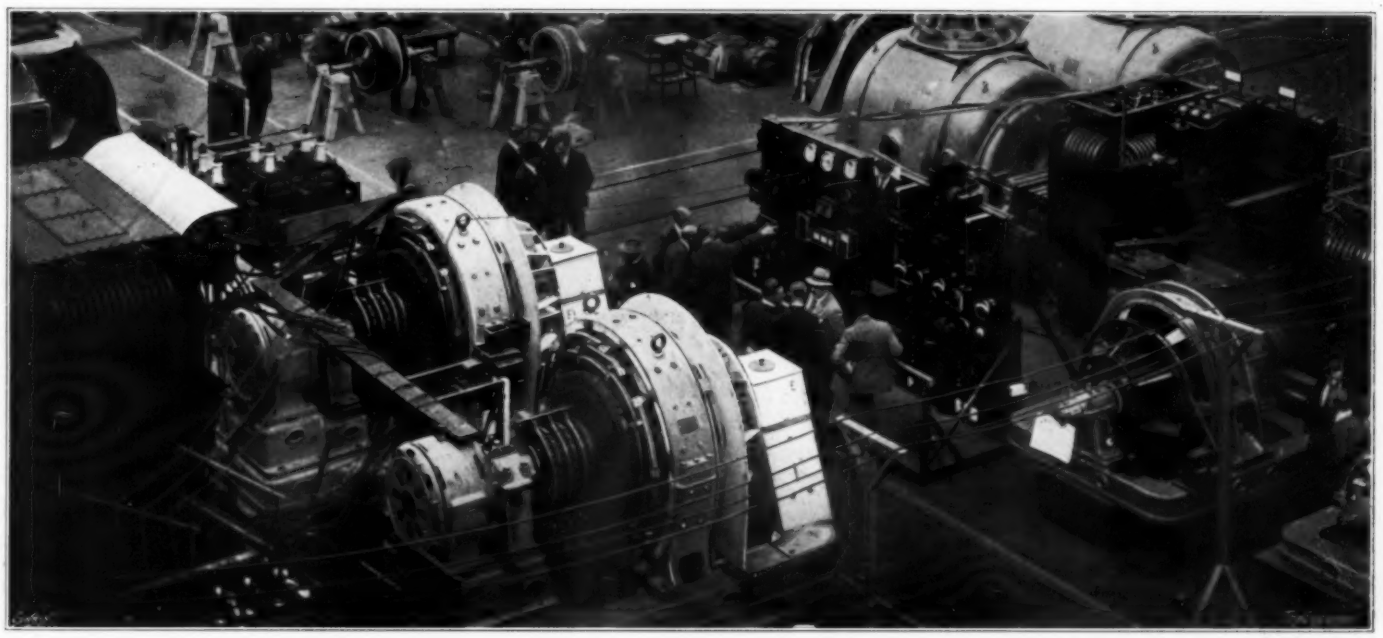
PARIS WATER SUPPLY.

IF the financial difficulties had not retarded progress during the year, the existing programme for bringing additional supplies of water to Paris would now be completed. As it is, little remains to be done to terminate the mains and pumping stations which are to deliver water from the Voulzie, Durteint and Dragon, and although the tapping of other minor sources has been contemplated, it is hardly likely that anything further will be attempted until the Municipal Council has approved of some more comprehensive scheme. The only ready means of increasing supplies is to extend the filtering beds at Ivry, the capacity of which has been considerably enlarged during the year. For the moment, Paris is sufficiently well provided with water, and there is no fear of a shortage for some years to come, unless trouble should arise with the old Vannes and Dhuis aqueducts, which are supporting a greater pressure than that for which they were originally built. The extension of Paris by the removal of the fortifications is giving far greater importance to the problem of an adequate water supply, to the extent that future requirements can only be met by embarking upon some vast undertaking that will ensure an ample supply for all time. The old scheme to bring water from the Lake of Geneva has long been abandoned, and the only two proposals now remaining are the construction of flood reservoirs in the upper valley of the Seine and the utilisation of the underground water in the Vals de Loire. The Municipal Council is being urged to lose no time in coming to a decision as to which of these alternatives should be adopted, the points to be considered being the quantity of water available, the accessory advantages of the scheme, and the economy in time and money in carrying out the work. Unfortunately, it is not easy to come to a prompt decision. The Vals de Loire scheme offers a practically unlimited supply of excellent water which can be conveyed to Paris from the pumping stations, mainly by gravitation, but local opposition is so uncompromising that there appears to be little prospect of the Municipal Council securing the necessary permission to utilise these resources. The construction of flood reservoirs on the Seine naturally suggests the possibility of their providing Paris with water, and as it has already been decided to test their efficiency by laying out one such reservoir, it is obvious that the Council will preferably entertain the idea of utilising the water if it is found to be suitable. As some authorities assert that the purity of the water to be impounded is open to doubt, and that there would be serious risk in drawing supplies from the reservoirs, it is possible that nothing will be done until after prolonged investigation into the bacteriological nature of the water available. Any solution of the problem appears therefore likely to be delayed for a considerable time. The reports at the Grenoble Congress upon the subterranean water supplies in the Dauphiné may possibly open up another field of research.

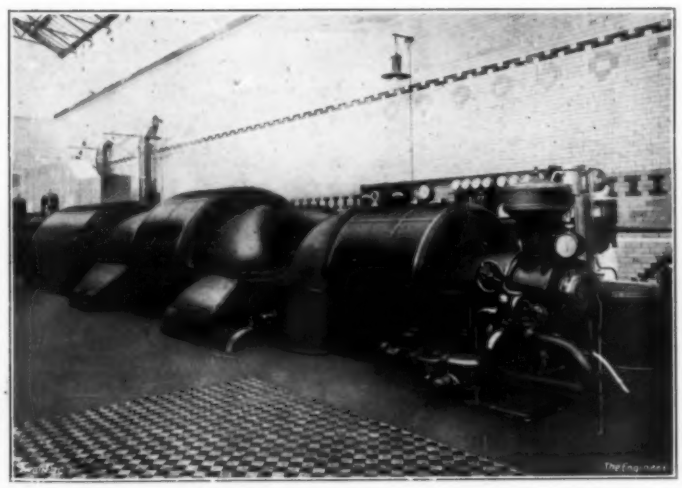
ELECTRICAL ENGINEERING IN 1925



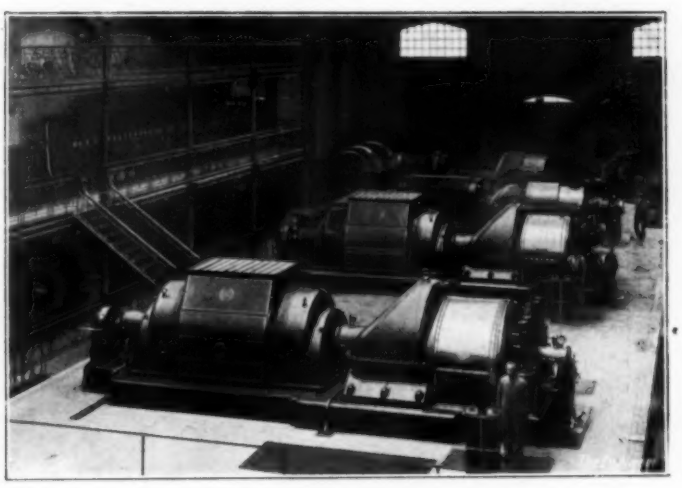
BARKING POWER STATION—40,000-KILOWATT PARSONS TURBO-GENERATOR SET



SUPERVISORY CONTROL EQUIPMENT FOR AUTOMATIC SUB-STATION—METROPOLITAN-VICKERS

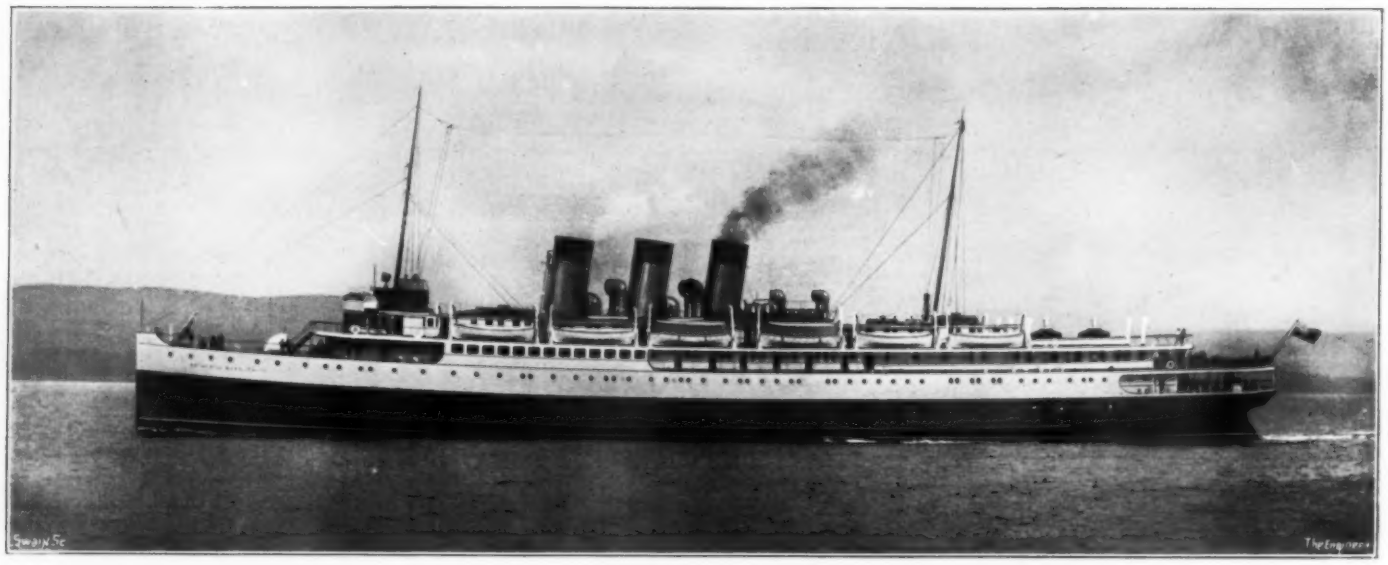


TURBO-GENERATOR AT BRADFORD ELECTRICITY WORKS

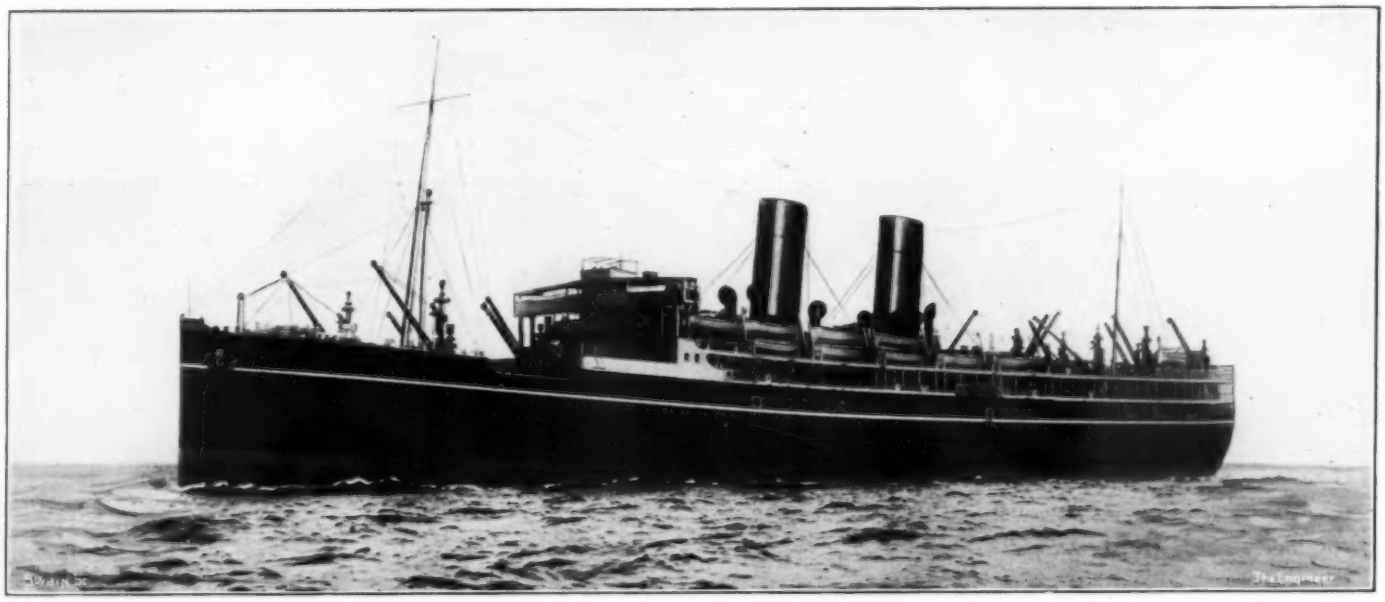


THE BOW GENERATING STATION

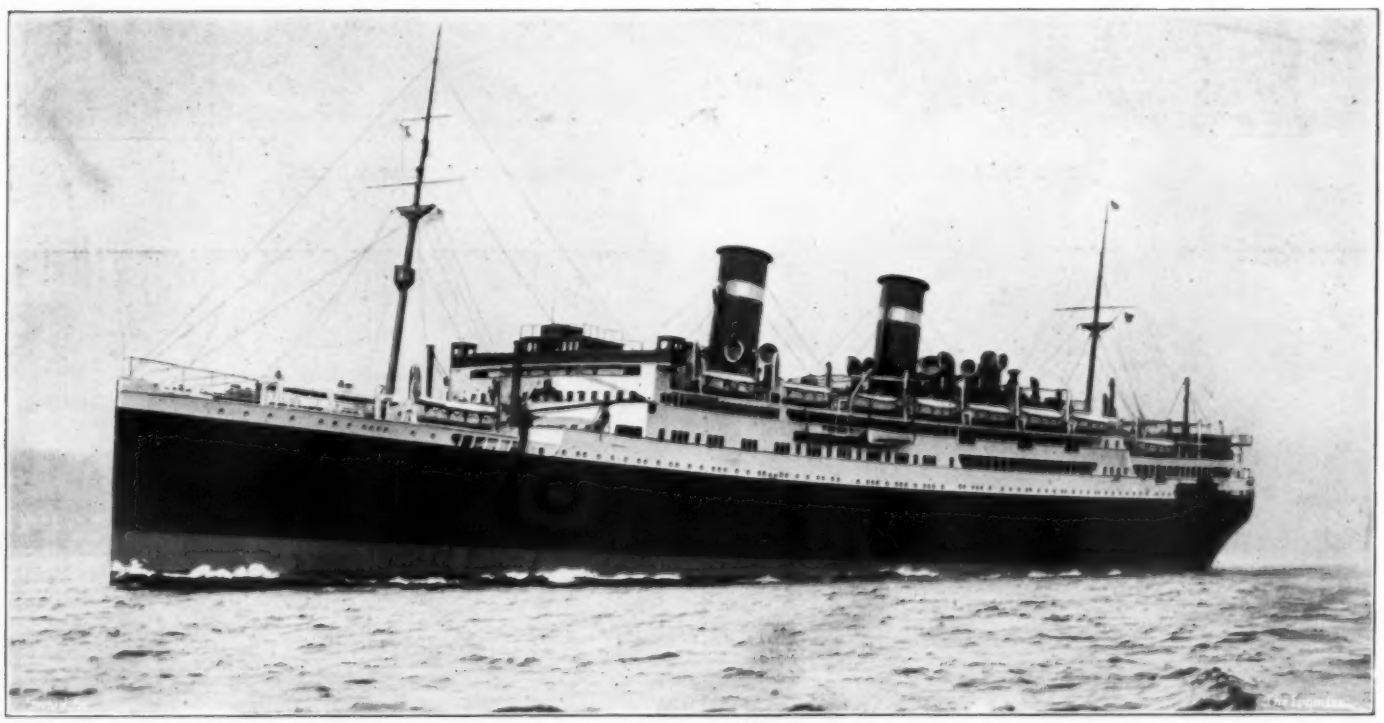
SOME LINERS OF 1925



THE CANADIAN PACIFIC LINER PRINCESS MARGUERITE

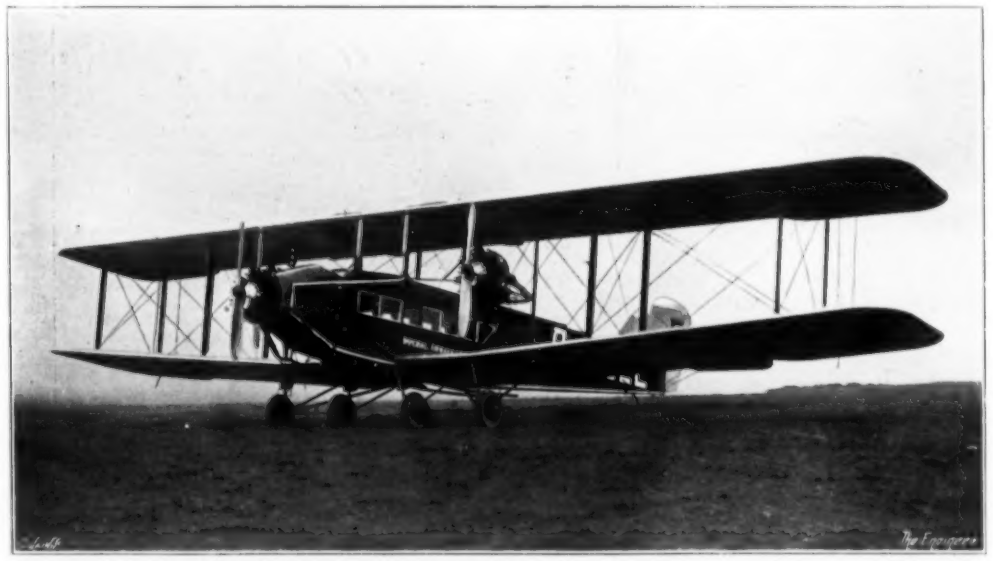


THE PENINSULAR AND ORIENTAL LINER RANCHI



THE LLOYD SABAUDO LINER CONTE BIANCAMANO

SOME AEROPLANES OF 1925



HANDLEY PAGE TRIPLE-ENGINED "HAMPSTEAD" PASSENGER MACHINE

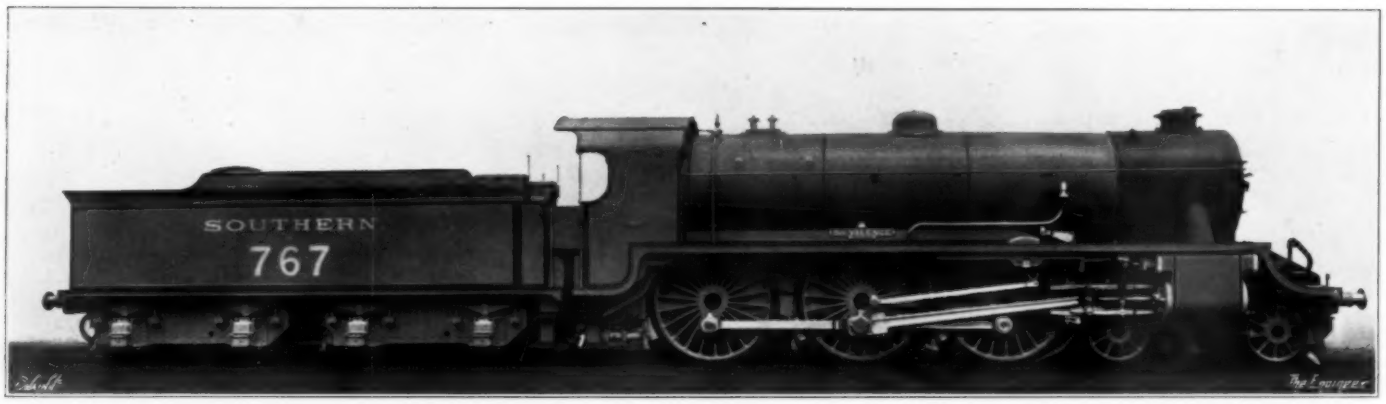
WESTLAND "YEOVIL" BOMBING MACHINE

VICKERS "VIXEN" TWO-SEATER MILITARY MACHINE

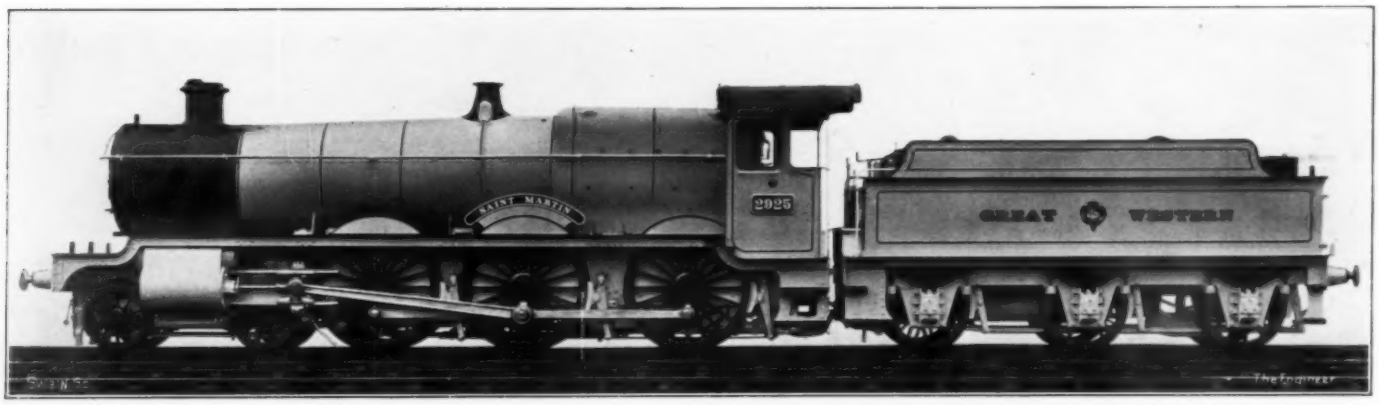
AVRO "BISON" FLEET-SPOTTING MACHINE

SOME LOCOMOTIVES OF 1925

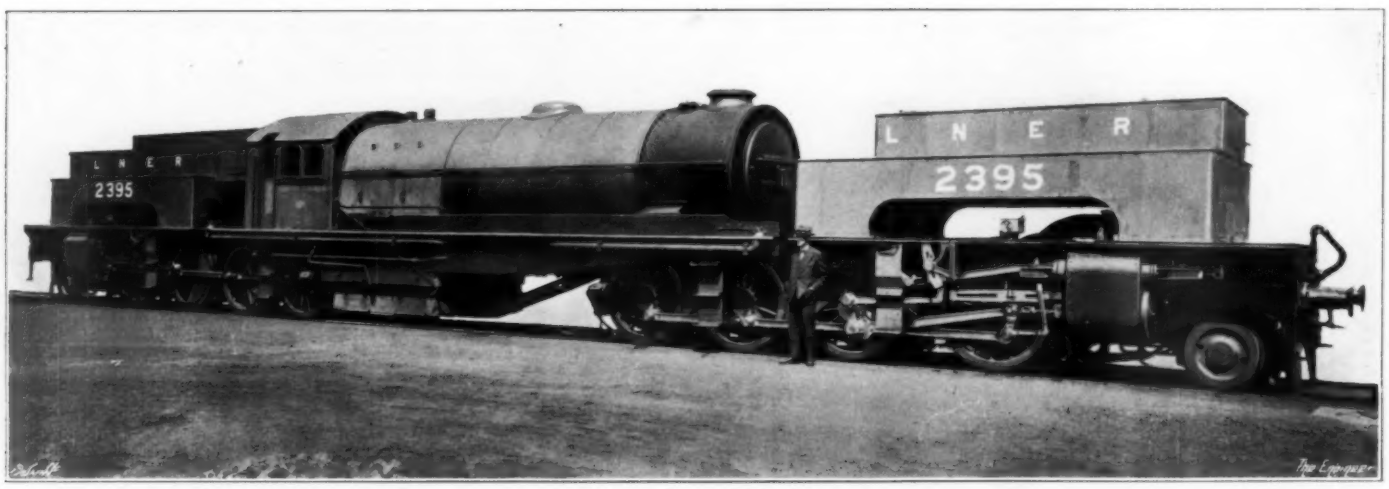
LONDON AND NORTH-EASTERN RAILWAY—"MIKADO" TYPE LOCOMOTIVE



SOUTHERN RAILWAY—EXPRESS PASSENGER ENGINE "KING ARTHUR" CLASS

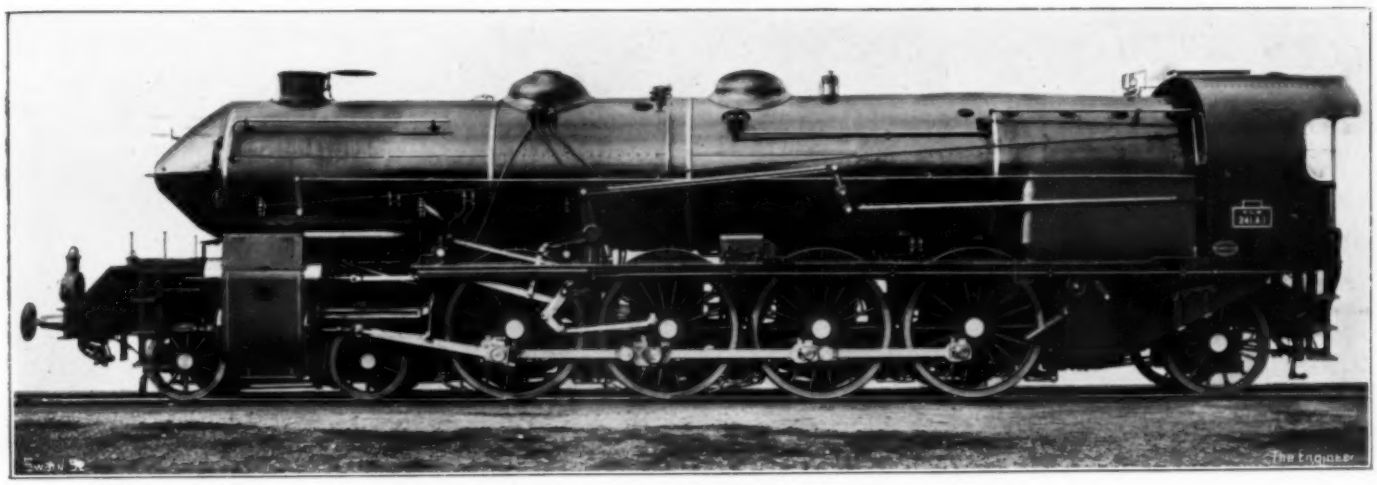


GREAT WESTERN RAILWAY—PASSENGER ENGINE "SAINT MARTIN"

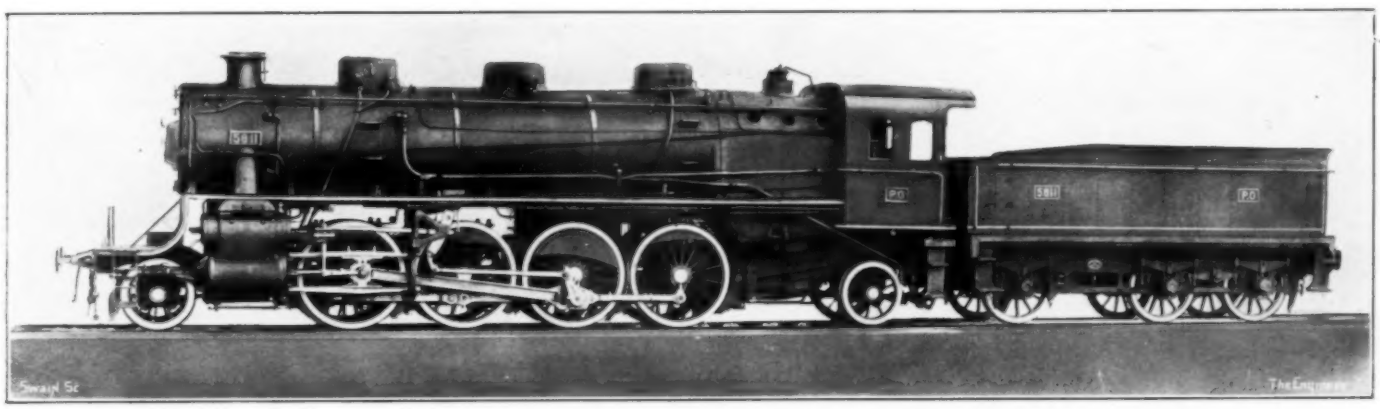


LONDON AND NORTH-EASTERN RAILWAY—GARRATT LOCOMOTIVE

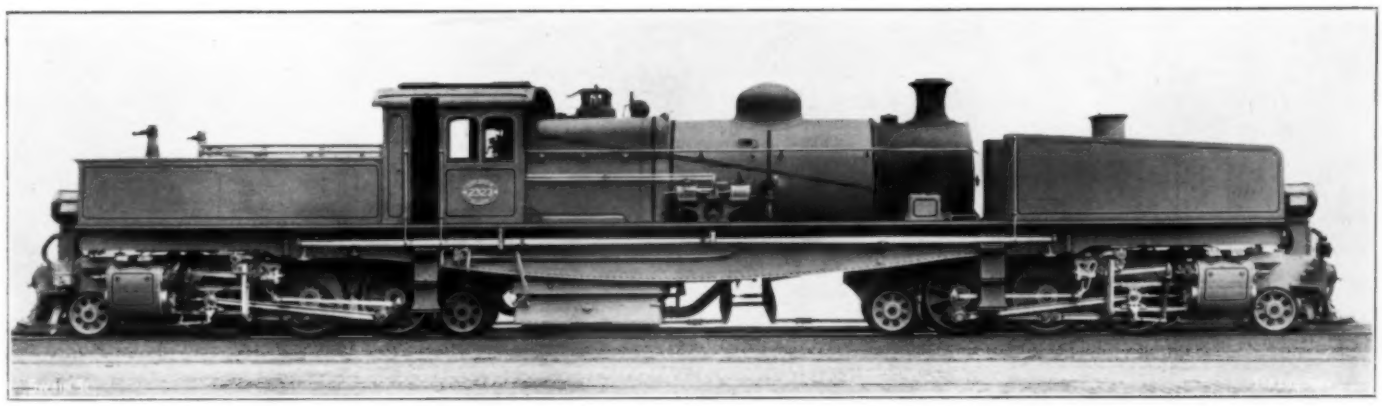
SOME LOCOMOTIVES OF 1925



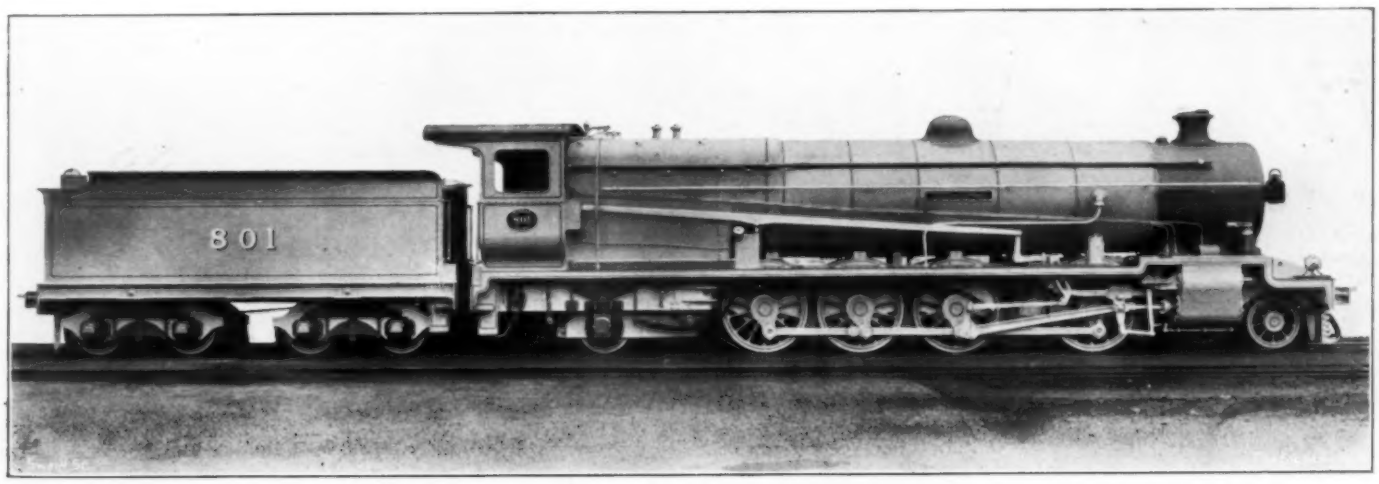
P.L.M. EIGHT-COUPLED COMPOUND PASSENGER ENGINE



PARIS-ORLEANS EIGHT-COUPLED PASSENGER ENGINE



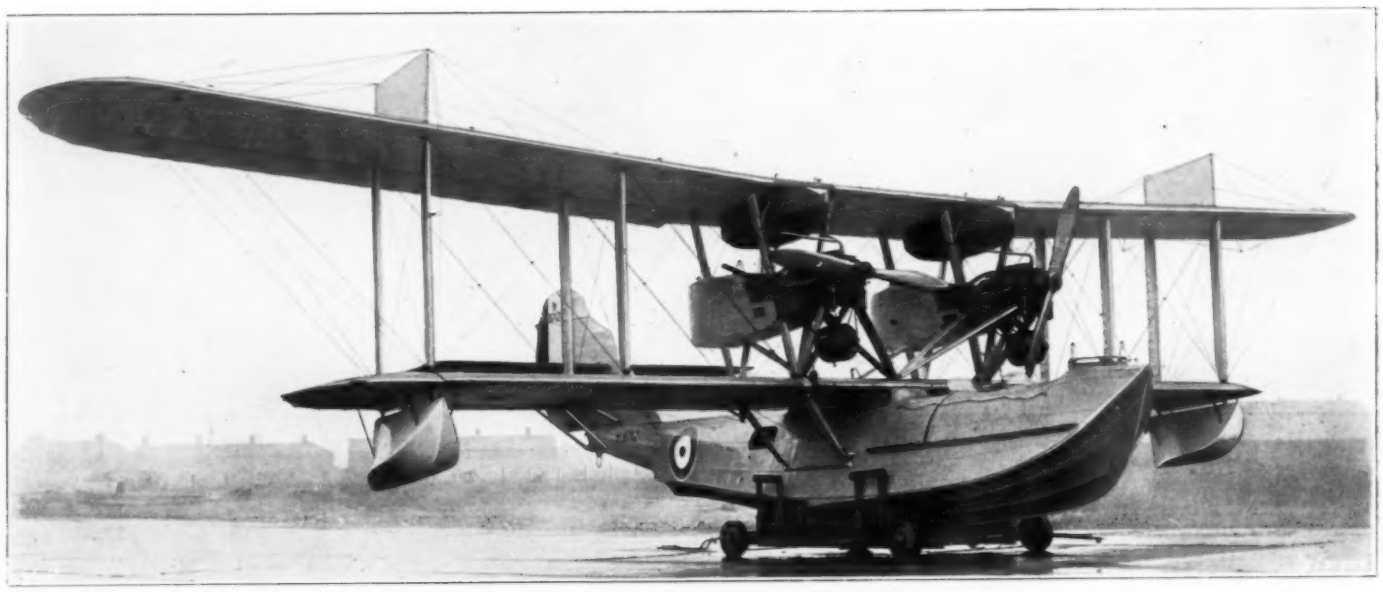
SOUTH AFRICAN GOVERNMENT RAILWAYS—MODIFIED FAIRLIE ENGINE (N.B. LOCOMOTIVE CO.)



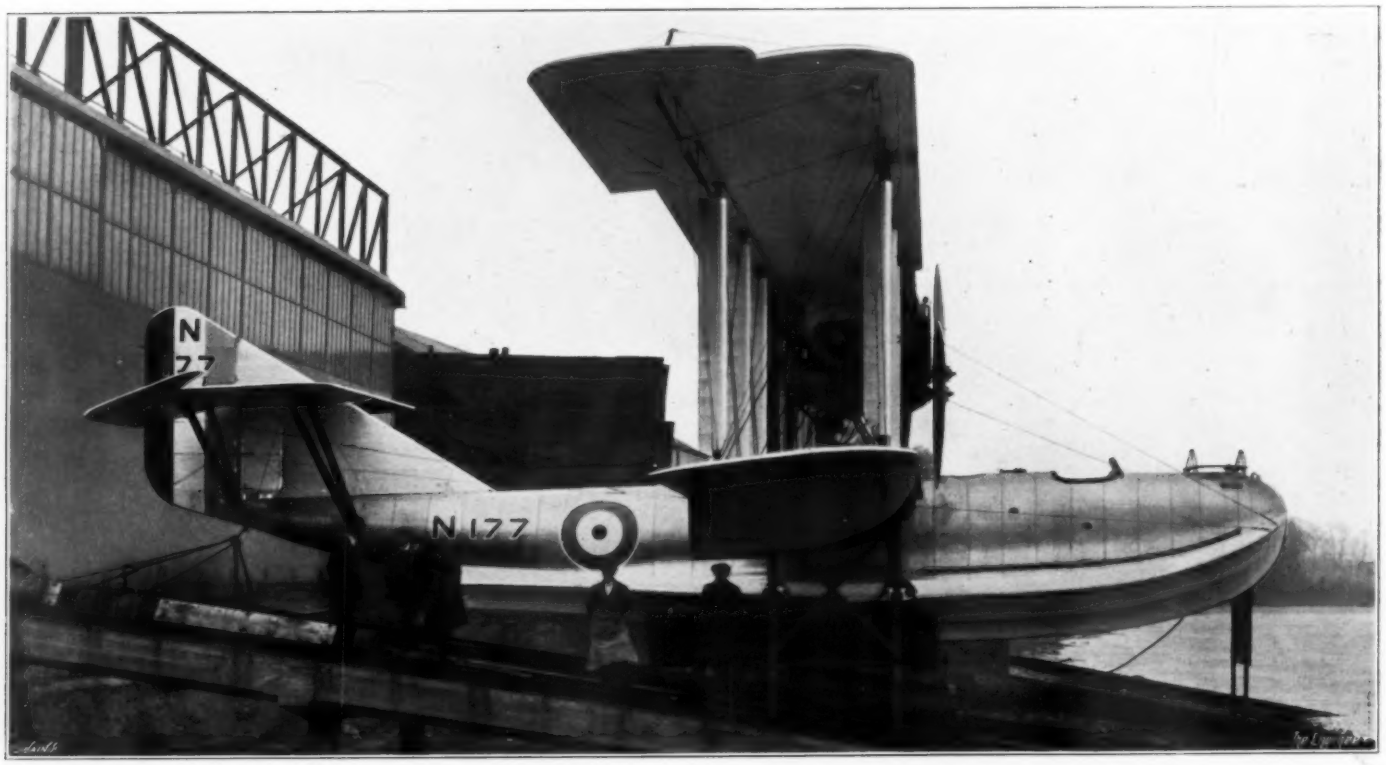
NIGERIAN RAILWAYS—THREE-CYLINDER NARROW-GAUGE LOCOMOTIVE (VULCAN)

SOME AEROPLANES OF 1925

VICKERS "VANGUARD" 25-SEATER PASSENGER BIPLANE

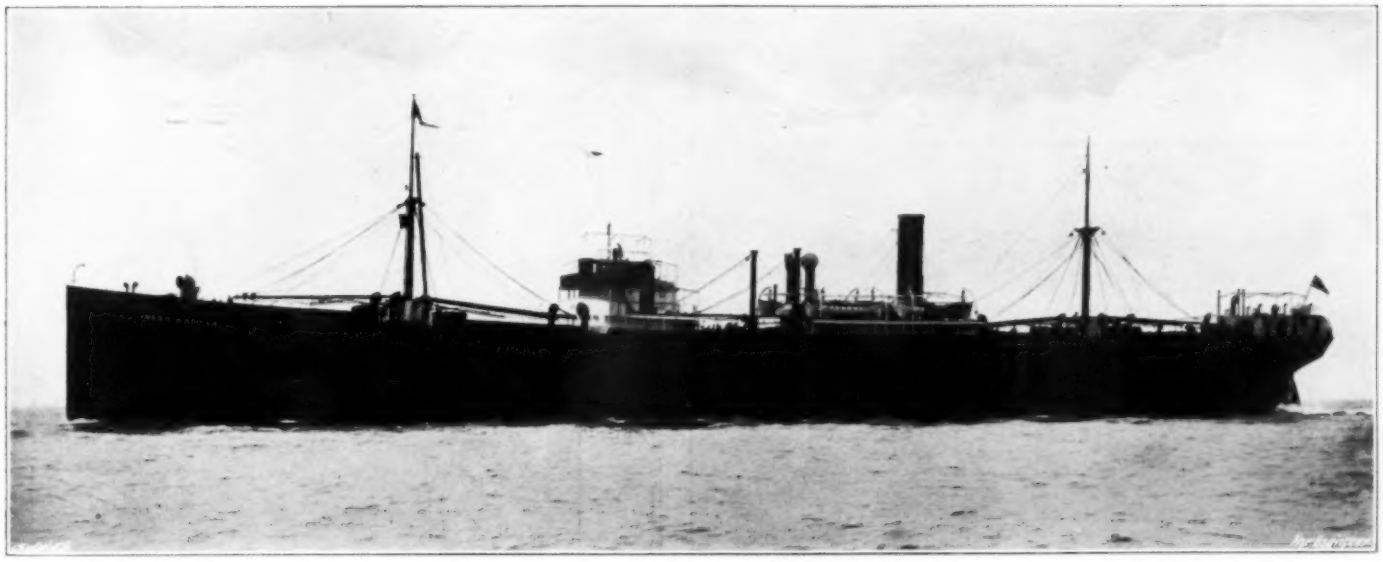


ENGLISH ELECTRIC COMPANY'S METAL-HULLED "KINGSTON" FLYING BOAT

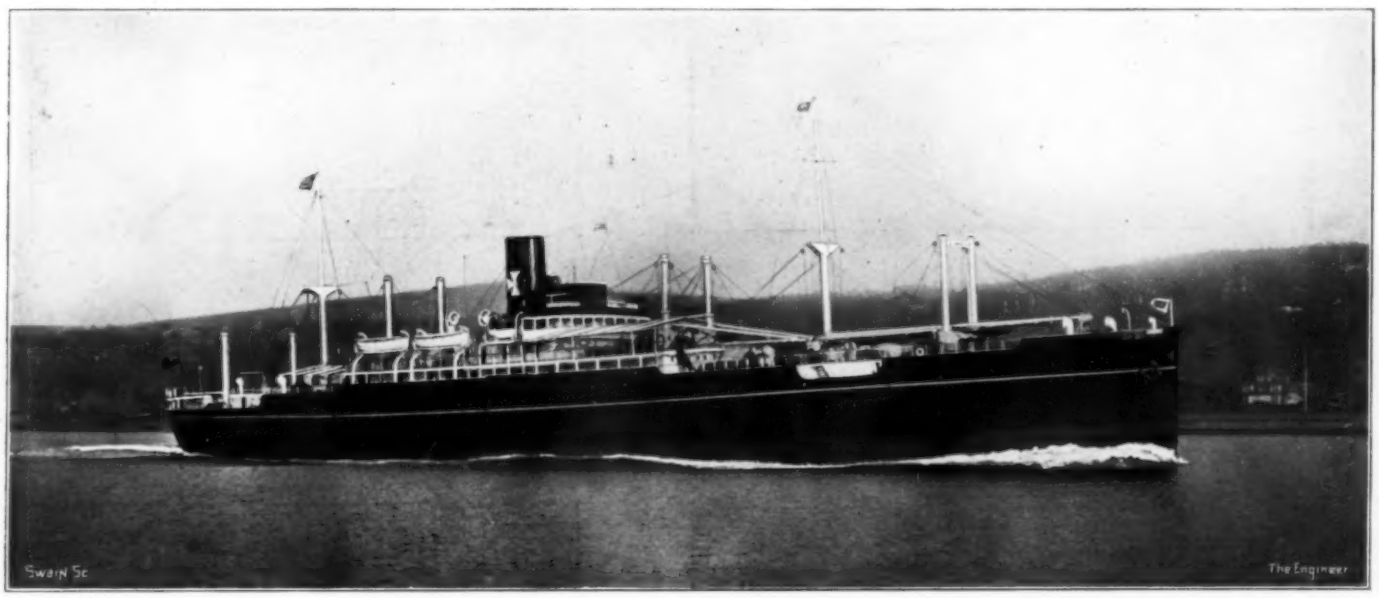


SHORT BROTHERS' METAL-HULLED FLYING BOAT

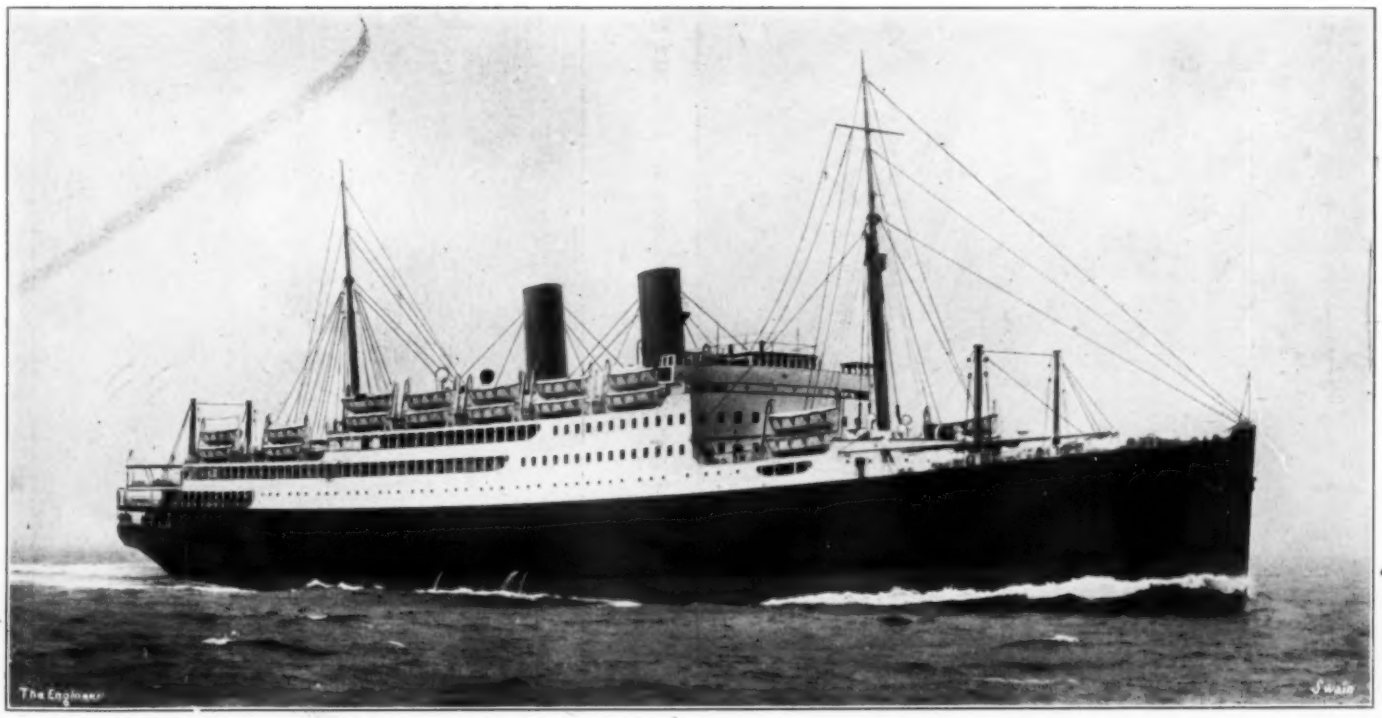
SOME MOTOR SHIPS OF 1925



THE MOTOR CARGO SHIP RABY CASTLE



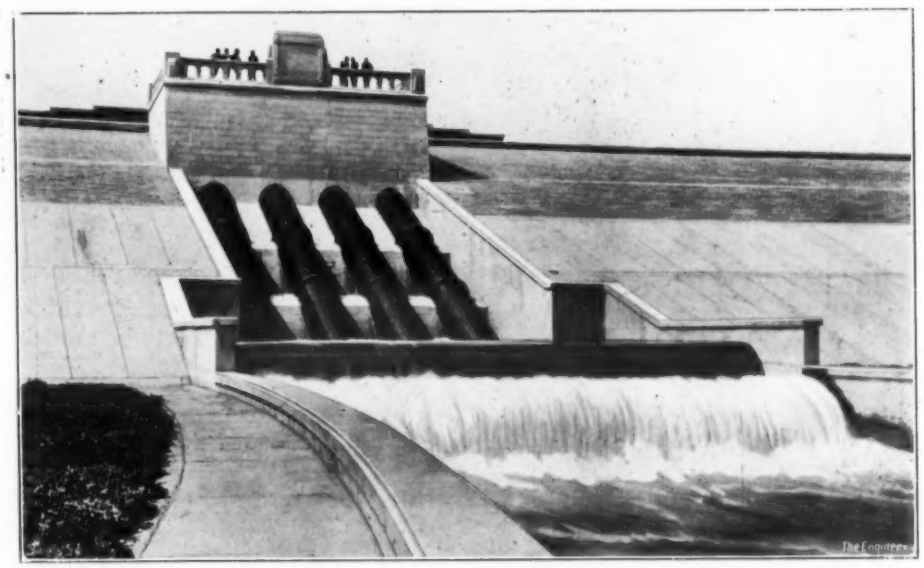
THE HOULDER LINE MOTOR REFRIGERATOR SHIP UPWEY GRANGE



THE SWEDISH AMERICAN MOTOR PASSENGER LINER GRIPSHOLM

THE SENNAR DAM—MASONRY SUPERSTRUCTURE COMPLETE, MAY 1st, 1925

WATERLOO BRIDGE—THE OLD AND TEMPORARY BRIDGES



THE "QUEEN MARY," LITTLETON, RESERVOIR—WEIR OF INLET BASIN

THE GEZIRA IRRIGATION SCHEME—HEAD REGULATOR, UPSTREAM VIEW

Railway Matters.

ANSWERING a recent question, the Under-Secretary for India said that the Khyber Railway had cost £1,897,000 to construct.

THE Western Australian Government has accepted an English firm's tender for 70 miles of railway rails with the option of taking an additional 100 miles at the same price. It is understood that the price was £100 a mile below the Broken Hill Company's tender.

THE Postmaster-General was, on the 16th ultimo, asked a question as to the ownership of Post Office sorting vans on railways. Sir W. Mitchell-Thomson's reply was that they were built by the companies at their own expense and an annual sum in respect of their provision, maintenance and haulage, calculated on a mileage basis for the journeys actually performed by the carriages, is included in the comprehensive contract payment for the conveyance of letter mails.

VERY severe weather prevailed in many parts of the country during Christmas week, and the depths of snow in places seriously interfered with railway traffic. The conditions were so bad in places that the Postmaster-General took the unusual step of issuing a public announcement that "in consequence of the bad weather prevailing in many parts of the country the long-distance mail trains have arrived at their destinations considerably behind time." No serious accident, however, occurred.

To Sir George Gibb, whose death occurred on December 17th, more than to any man was the North-Eastern Railway indebted for changing its old-fashioned methods of operation into as progressive ways as were to be found on any railway in this country. He was a great admirer of some American methods, *e.g.*, the big wagon, ton and passenger mile statistics, divisional instead of departmental administration, the use of the terms "freight traffic," "yardmaster," &c., and, for good or ill, he was the first British general manager to recognise trade unions in 1897.

AFTER a comparative freedom for some months from serious railway accidents in France, there was one on the Est system at Noisy-le-Sec on December 22nd. An express, which left Basle for Paris just after midnight, when travelling at a high speed, ran into an obstruction and was derailed. A bad case of telescoping between a sleeping car and a third-class carriage occurred, and whilst no one was killed outright, a guard subsequently died from his injuries. The obstruction, is said to have been a "flat trolley" used for transferring trucks from one line to another. We judge that a traverser is referred to, and that it was left foul of the up main line. It could not have been in use at the time, or the interlocking would have kept the signals "on."

THE Ministry of Transport railway statistics for September, mentioned in this column of our issue of the 25th ultimo, also gave some particulars of the business done during the first nine months of the year and make a comparison with the corresponding figures for 1924. The number of passenger journeys suffered a decrease of only 0.5 per cent., but the receipts therefrom fell by 2.0 per cent. Parcels traffic enjoyed, however, an increase of 2.3 per cent., and so the total passenger receipts were only 1.2 per cent. down. Passenger train mileage increased by 2.9 per cent. In goods traffic the tonnage of general merchandise fell by 1.9 per cent.; coal, coke and patent fuel by 9.2 per cent.; and other minerals 4.2 per cent.; and of all goods traffic 6.8 per cent. The receipts from general merchandise were only 0.2 per cent. less. Those for coal, coke and patent fuel fell 7.0 per cent., and the total goods receipts by 3.0 per cent. The goods train mileage decreased by 2.1 per cent.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first nine months of the present year was as follows, the corresponding figures for 1924 and 1923 being added in brackets:—Locomotives, £2,184,503 (£1,491,348, £2,117,597); rails, £1,456,600 (£1,273,257, £1,876,411); carriages, £1,148,307 (£877,147, £770,698); wagons, £2,545,456 (£2,574,954, £2,272,359); wheels and axles, £452,842 (£446,453, £724,174); tires and axles, £320,609 (£474,322, £455,302); chairs and metal sleepers, £686,465 (£959,805, £734,489); miscellaneous permanent way, £1,005,551 (£853,700, £838,153); total permanent way, £4,067,738 (£4,170,371, £4,865,077). The weight of the rails exported was 154,616 tons (138,169 tons, 208,780 tons), and of the chairs and metal sleepers, 61,390 tons (76,242 tons, 64,337 tons). During the month of September last the value of the locomotives exported was £134,707, which included the following:—The Argentine, £67,292; India, £54,354; the value of the rails exported in September was £109,014, which included the following:—South Africa, £22,738; India, £18,186; Portuguese East Africa, £17,893; the Argentine, £12,950; British West Africa, £3837; New Zealand, £1884; Australia, £1192.

ACCORDING to the *Electrical Times*, the new tube extensions from Clapham to Morden and from Charing Cross to Kennington *vid* Waterloo are expected to be in service next midsummer. It is expected that 5577 trains a day will serve the various terminals of the Hampstead and City lines together with their extensions. During each rush hour thirteen trains in each direction will run between Morden and Golders Green *vid* the City. During the slack mid-day period Morden trains will run to Edgware *vid* Charing Cross; seventeen trains an hour will be the service in each direction. During rush hours twenty-six trains will run in each direction between Tooting and Euston, Golders Green and Highgate *vid* the City, and the same number of trains per hour will run from Tooting to and from the Edgware line *vid* Charing Cross, and Euston *vid* the City during slack hours. From Kennington fifty-four trains an hour will be provided during busy times, serving Euston, Golders Green, and Highgate *vid* the City, and to Highgate, Colindale and Edgware *vid* Charing Cross. During slack periods fifty-one trains an hour will operate from Kennington to and from Euston and Golders Green *vid* the City, and to and from Highgate, Colindale and Edgware *vid* Charing Cross. The operation of these services will entail the employment of about 300 additional men as motor men, guards, and station staff.

Notes and Memoranda.

A FORD car, with a roadster body, was recently taken, in a broken-down condition, from Chicago to Cleveland by aeroplane, and on arrival was assembled in fifty-one minutes ready to drive away.

ACCORDING to Mr. L. J. Jones, the New South Wales Geological Surveyor, the Newcastle coalfield contains over 2000 million tons of high-grade coal, together with 6000 million tons of a lower grade.

AN extensive report, by the Fuel Research Board, on the physical and chemical characteristics of the Smith seam of the Lancashire coalfield, has just been issued by H.M. Stationery Office, at the price of 1s. 6d. net.

LABORATORY tests of 6in. by 12in. concrete cylinders broken in compression over periods up to one year by the North Carolina State Highway Commission tend to show that diatomaceous earth included in the mix increases strength and promotes workability.

WHAT, it is claimed by the *Contract Record*, will be the largest terminal warehouse on the North American Continent is to be built on the harbour front at Toronto. The building is to be 500ft. by 580ft. and eight storeys high. There will be over a million square feet of floor space.

ACCORDING to Mr. J. B. Tyrrell, the Canadian geologist, it should be possible to carry on mining for gold in the Porcupine and Kirkland Lake districts of Canada to exceptional depths as the rock temperature at the surface is only 35 deg. and there is an increase of 1 deg. for every 200ft. of depth. At a depth of 10,000ft. the temperature should be only 85 deg.

IN the course of a paper read before the Hardwood Millers' Association of Victoria, Mr. V. B. Trapp said that the wood borer *lyctus Brunneus* had been imported into Australia. It attacked sap wood, but not the heart of native hardwoods. He thought, however, that it would be possible to exterminate the pest in a few years if the proper precautions were taken.

DATA of interest to those engaged in the testing of concrete will be found in Bulletin 16 of the Structural Materials Research Laboratory, Lewis Institute, Chicago, "Effect of Size and Shape of Test Specimen on Compressive Strength of Concrete," by Harrison F. Gonnerman. The report is reprinted from the 1925 "Proceedings" of the American Society for Testing Materials.

IN giving evidence to the Australian Railways Standing Committee, Mr. R. Liddelow, Secretary of the Victorian Electricity Commission, said that the average moisture content of the coal from the new open cut at Yallourn is approximately 65 per cent., and the calorific value as fired to the boilers about 3800 B.Th.U. Similar values for the old open cut coal are 50 per cent. and 5600 B.Th.U.

ACCORDING to the *Electrical World*, the Chicago City Council has appropriated 125,000 dollars from the vehicle tax fund for the purpose of installing street and warning signs at the intersection of through streets. After trials with about twenty forms of apparatus an illuminated sign, in the form of a shield with a lighted lens in the centre, has been adopted as the standard. A total of 665 of these signs has been installed, at a cost of 123 dollars each. The upkeep is undertaken by the street lighting organisation.

STATISTICS relating to the production of lamps in Germany are given in the *Illuminating Engineer*. Apparently there has been, despite increased internal demand, a reduction of 10·5 per cent. in the total production of electric lamps, and 2·5 per cent. for gas mantles for 1924, as compared with 1923. This arises from the marked diminution regarding exported products, for which the shrinkages are 19·5 per cent. and 17·8 per cent. respectively. These results are attributed mainly to the effect of foreign tariffs.

AMONG the suction dredgers being used on the improvement of the Willamette River in Oregon there is one of 2000 horse-power, in which steam turbines drive the pump, presumably through gearing, running at 280–300 revolutions per minute. It can deliver the spoil through a pipe line a mile long. Another of the dredgers has four Diesel engines totalling 3400 horse-power, which drive the pumps electrically. One of the booster pumps used on the pipe lines is of 1600 horse-power and is driven by an electric motor served by a submerged 11,000-volt cable.

IN co-operation with the Safety in Mines Research Board of the British Government, an investigation to determine the relative safety in the use of cushioned blasting obtained by the use of an air space or rock dust stemming is being undertaken by the American Bureau of Mines at its Pittsburg Station. An investigation to determine the effect of gas composition, stemming and stemming material on the charge limit of a permissible explosive as affecting the safety of the use of permissible explosives in gaseous and dusty mines has also been undertaken.

DEALING with the treatment of lead poisoning, in a lecture to the American National Safety Council, Dr. W. F. Boos said that the main organ of excretion is the liver, and therefore its activity should be stimulated by bile or bile salts medication, coupled with a good cathartic, such as liquorice powder. As a result of this medication we get relief of constipation and increased elimination of lead from the system. The local paralysis should be treated by the air-cooled ultra-violet lamp in conjunction with massage. Potassium iodide may help to improve the general conditions, but as a lead eliminant it is a fallacy.

IN the gale of Friday, November 13th last, a barge built on the Ellis channel system and belonging to the New York Central Railroad Company, tore loose from her tow off Execution Rocks, Long Island Sound. Driving before wind and sea, she pounded her way through an almost impassable barrier of shoals and rocks and piled up on the windward shore of David's Island. She lay there askew, supported only by sharp rocks, which at either end of the hull carried her entire weight. Next day she was floated off and towed safely to New York. Later examination showed that not a line in the hull structure was deflected or a seam opened, and no rivets were loosened in spite of the terrific pounding to which the barge was subjected.

Miscellanea.

BORING for oil has been started on Prince Edward Island, Canada.

A PROPERLY equipped assay laboratory has been opened at Lydenburg, South Africa.

IT is reported that the Michelin Company proposes to manufacture its tires in England.

A FACTORY for the manufacture of asbestos cement is to be erected at Yarraville, Australia.

IT is proposed to build a bridge across the head of Spencer Gulf at Port Augusta, South Australia, at a cost of £30,000.

THE Corporation of Newcastle-on-Tyne proposes to expend £975,000 on the construction of a new quay, and £931,000 on road-making.

THE annual Exhibition of the Physical Society of London and the Optical Society is to be held on January 5th, 6th and 7th, at the Imperial College of Science and Technology, South Kensington.

THE output of spelter from the Seaton Carew Works for the past year was 5836 tons, as compared with 4944 tons for 1924. The production of sulphuric acid was also increased, from 10,630 tons up to 13,141 tons.

THE gates for the Canadian Government graving dock at Victoria, Vancouver Island, are being built at Yarrow's local yard. The gates each require more than 1000 tons of steel, and the dock will be the largest on the Pacific Coast.

A MELBOURNE firm has, according to the *Industrial Australian*, succeeded in making a motor roller which is considered to be of superior quality to imported rollers, and at a competitive price. A Diesel engine supplies the motive power.

WORKING of the cinnabar deposits at Kamloops Lake, British Columbia, is, says the *Chemical Trade Journal*, to be started again soon after a cessation of thirty years. The workings were discontinued in 1895 because of the low price of mercury.

ACCORDING to Mr. Allan Cobham, it should be possible to maintain an aeroplane service between Cairo and Khartoum, both by day and by night. At present the mails take five days to cover the distance, but by air it could be done within a day.

AMONG the tenders invited by the Egyptian State Railways, there are one for 300,000 steel sleepers, with clips and bolts, January 19th; another for about £2000 worth of drawing-office materials, January 19th; and one for 1000 open low-sided wagons of 10 tons capacity, January 21st.

A NEW industry for South Africa has been started by the manufacture of nuts and bolts near the Ferreria Deep, Johannesburg. The extent of the equipment is not mentioned in the account given by the *S.A. Mining and Engineering Journal*, but the capital of the company is given as being £18,000.

THE Commercial Secretary of the Department of Overseas Trade at Berlin reports that, according to a Press report, the Ministry of Transport and the Ministry of Food and Agriculture are arranging for a prize competition, beginning in the spring of 1927, for the construction of a caterpillar tractor suitable for transport and agricultural and forestry purposes. A draft of the directions describing the qualities, which it is desired the caterpillar tractor should have, has been prepared and is obtainable from the Ministry for Food and Agriculture, Berlin W. Wilhelmstrasse 72.

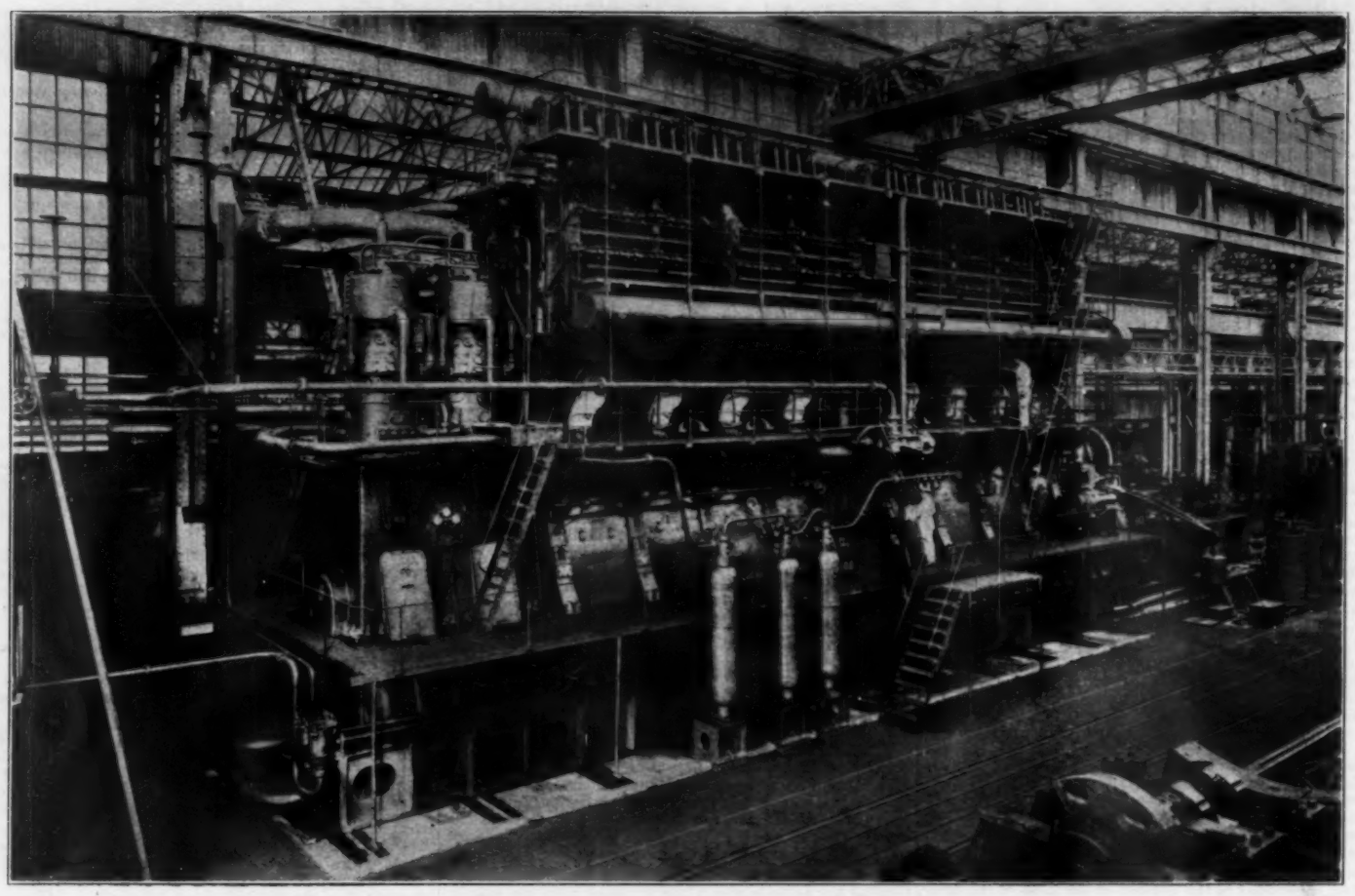
FOUR schemes for the supply of water to Sutherland, Cronulla and New South Wales south coast towns have been submitted to the Sydney Metropolitan Water Board by its chief engineer. The first proposes to utilise O'Hare's Creek, at an estimated cost of £882,000, for reservoir, tunnel, mains, &c. Scheme No. 2 provides for a dam on the (upper) Woronora River, which, with other works, would cost £508,000. The third scheme, also associated with the Woronora River (lower), is that which the Parliamentary Works Committee reported on in 1921 as not being expedient to carry out. The estimated cost is £332,000. Scheme No. 4 provides for augmenting the supply to Port Kembla, Wollongong, and the south coast towns, by pumping from the Cordeaux reservoir, now being constructed for the Sydney supply, at an estimated cost of £128,000.

ACCORDING to a report recently issued by the Austrian Ministry of Commerce and Communications, there were at the commencement of last year fifteen hydro-electric stations in operation in Austria, with an individual maximum capacity of over 500 horse-power, representing an aggregate of 80,820 horse-power. There were also 522 stations of less than 500 horse-power each, the total in this case being 8267 horse-power. No fewer than 244 new hydro-electric stations, representing a total of 292,754 horse-power, were in course of construction in Austria at the beginning of 1925. The bulk of these plants are of small capacity. There are, however, twenty-four large plants, with an aggregate rating of 286,530 horse-power, in course of construction, the most important being the Luner Lake Station of 60,000 horse-power, which the Vorarlbergen Ilwerke Gesellschaft is erecting in the Vorarlberg.

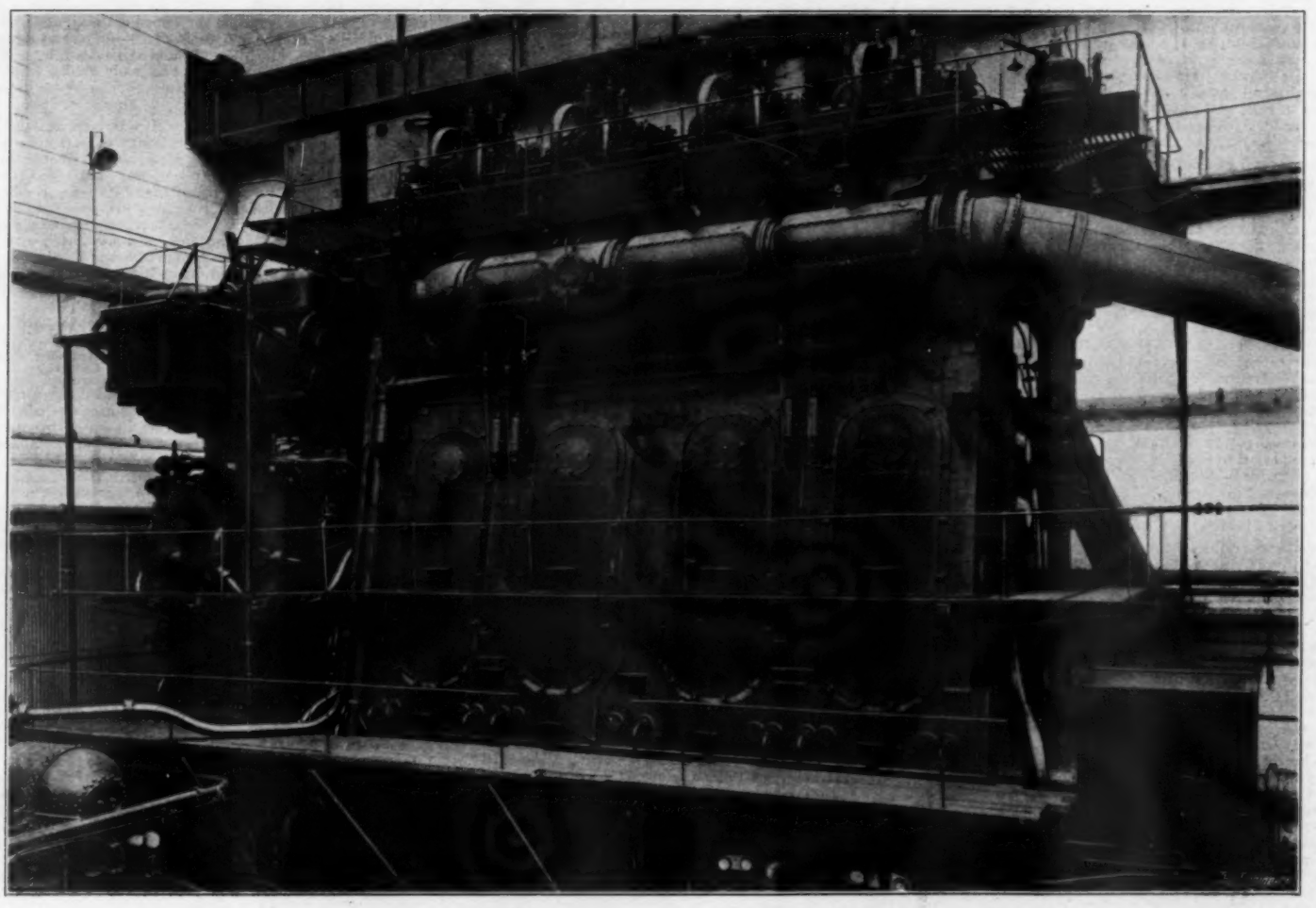
IN a paper on "The Development of Water Power Resources," read before the Liverpool Engineering Society, Mr. A. E. Malpas analysed the findings of the Water Power Resources Committee, which were published by the Board of Trade in 1921. He reviewed separately the water power available and developed in each country of the British Isles, and also Norway. In dealing with Ireland, he gave considerable attention to the Shannon scheme. With regard to Scotland, he said that steps had been taken under the Lochaber Power Act to extend the activities of the British Aluminium Company, Ltd. The new extension would bring the installed capacity of the plant up to 107,000 electrical horse-power. The aggregate amounts of undeveloped water power in the countries of Great Britain in 1921, said the author, were:—Scotland, 194,965 kilowatts; Wales, 35,900 kilowatts; and England, 20,440 kilowatts.

MARINE OIL ENGINES OF 1925

(*For description see page* 17)



ONE OF THE MAIN ENGINES OF THE MOTOR LINER ASTURIAS



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*** With this week's number is issued Two Four-page Supplements illustrating the progress in 1925 of Electrical and Civil Engineering, Steam and Motor Ship Building, Locomotives and Aeroplanes. Every number, as issued by the Publisher, contains copies of these Supplements, and Subscribers are requested to notify the fact should they not receive them.*

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TWO FOUR-PAGE SUPPLEMENTS—ELECTRICAL ENGINEERING, LINERS, AEROPLANES, LOCOMOTIVES, MOTOR SHIPS AND CIVIL ENGINEERING IN 1925.

"The Engineer" on the Continent.

We have consistently endeavoured to keep our readers informed as to all engineering developments of importance which have taken place in other countries than our own. In this work we have been served by local correspondents, by frequent visits of London representatives to foreign countries, and by the periodical appointment of special commissioners. We feel, however, that the time has come when it is no longer possible to follow adequately by these means alone all the important engineering work that is being done in Belgium, Germany, France, Italy, and other parts of Europe, and we have therefore appointed Mr. R. H. Parsons as a special editorial representative of THE ENGINEER *on the Continent. Mr. Parsons is well known to many of our readers, and it is quite unnecessary to inform them that he is a fully trained and competent engineer and an experienced writer. He will take up his duties, with Brussels as his headquarters, on Monday next. In order to provide for the increased supply of material that will come to our hands from the Continent through his exertions it is our intention to increase the average number of editorial pages. At the same time that this enlargement is made we shall continue the publication of* THE METALLURGIST, *the monthly supplement to* THE ENGINEER, *which, after the experience of a year, we are satisfied is meeting an existing need, and we shall in no way diminish our attention to British engineering or depart from our policy of publishing articles by expert contributors. We express a hope, that at a moment when signs of improving industry are not lacking, these efforts will be appreciated.*

THE ENGINEER.

JANUARY 1, 1926.

A Retrospect of 1925.

TRADE is improving. Even those who persist in taking a gloomy view find themselves bound to admit that the bottom of the depression has been reached. During the last few months unemployment gradually decreased, and in every branch of the engineering and allied industries, shipbuilding alone excepted, business improved. The anxiety which weighed upon engineers in the early months of the year was replaced first by hopefulness and finally by a feeling of certainty that better times were, after many broken promises, at last upon their way. Those who rejoice in finding direct causes of all effects may attribute the change to the coming of a stable Government, with a business man at its head, to the reduction of taxation, to the better spirit which prevails between employers and employed, to the Safeguarding of Industries, the improvement of currency, or even to the Coal Subsidy. For ourselves, we are inclined to believe that it is no more than the beginning of reaction from the results of the war and that history in this case is repeating itself.

With better trade we hope to see a return of that self-confidence which was, just about one hundred years ago, when prosperity was returning after the cessation of another war, an asset of incalculable value to Englishmen. In the last fifty years we have surrendered some of that strong belief in ourselves to the teaching of those who insist that other nations are greater than the British nation, and that pride in ourselves and our own works is both unseemly and unwarranted. It is unseemly only when it is a cause of reviling in others, and if it begins by being unwarranted it soon ceases to be so, for with increasing self-reliance power augments. In the engineering industries we have seen too many British inventions neglected until, dressed in a foreign guise, they have returned to our shores and received a ready welcome. With such a record of great inventions as this land has to its credit we do not doubt for a single instant that it is as capable as any other nation, and more capable than most, of producing whatever the world needs. But a general readiness to believe in our own abilities and less readiness to seize upon foreign introductions is essential. Reform cannot come by stamping "Buy British Goods" on our envelopes, but by a constant determination to believe that the British race is as capable to-day as it was a hundred years ago, and that we need not go outside the bounds of our own Empire to find the best that the world can offer.

Marine Engineering.

Those who consult the pages of the past year's history which occupy the greater part of this issue of THE ENGINEER will perceive that, in the face of many difficulties, a great deal of good work was done. Shipbuilding was the most unhappy of all national industries, but even in it we find many important events to record, for several notable vessels were launched and several were completed. A very favourable aspect is the firm hold which we have now taken of the motor ship. We have to our credit, not only the construction of the largest motor liner—the Asturias, by Harland and Wolff—but it is clear from the records of the past twelve months that the proud position which Great Britain holds in steamship building has now been definitely secured in motor ship building also. The total number of motor vessels completed reached, it will be seen from a table on page 17, forty-four. Our nearest competitor was Germany, with well over thirty; the rest were without exception far less. We have also advanced more boldly in design and have to our credit the biggest motor cylinders in the world, the Brown-Sulzer 35½in. cylinders. Whilst to the discredit of the nation and of the acumen of British shipbuilders we have to admit that many of the engines are foreign in original design, we are glad to be able to say that British influence is having its effect and that the unparalleled experience of marine engines which we have accumulated in steam practice is being turned to account in marine internal combustion engineering. Moreover, several purely British engines have made appreciable progress since they first appeared.

In steamship construction there is little new to report, but the long-anticipated step towards the super-pressure marine turbine was made in the middle of the year, when an order was placed with Denny Brothers for a Clyde steamer which is to have Parsons turbines and Yarrow boilers for a pressure of 550 lb. per square inch. Before the present year is half out this vessel should have undergone her trials, and Sir Charles Parsons' claim that an economy equal to that of the oil marine engine can be obtained with the steam turbine will have been settled one way or the other. There is, indeed, no reason for supposing that very high pressures will not prove as economical afloat as ashore, and for land work they are now firmly established. Fluctuations still take place, but no one can doubt that the day of what we may now call low pressures is passing, that in a short time we shall regard 350 lb. as moderate pressure, that the more adventurous spirits will adopt 500 lb. to 550 lb., and that the most daring will, following Jacob Perkins of illustrious memory, employ 1000 lb. and even higher pressures. The matter is full of delightful problems which should provide joy upon joy for the young engineers before whom a new era of steam engineering is opening. Boiler design will need careful revision, in heat storage, which becomes more essential as pressures increase, we shall see justice done to the memory of Dfuitt Halpin, metallurgy will have to play its part, and the design of steam mains and valves will become a profession in itself. Just as the coming of the Trevithick high-pressure engine caused the development of a mechanical engineering different from that of Watt, so we may anticipate that the expanding use of super-pressures will lead to modifications of current designs. The future is with these

pressures, and engineers must gird up their loins to meet them.

Locomotives.

Nineteen-twenty-five will always be remembered by the present generation of engineers as a railway year. In it we celebrated the conclusion of the first hundred years of the existence of public railways. The centenary date was September 27th, but to meet the convenience of the International Railway Congress which met in London in June, the celebration was held early in July, when a never-to-be-forgotten procession of old and modern locomotives moved in stately sequence upon the very route which a hundred years ago made history. It was a wonderful occasion. Whilst it brought home to us the nearness of the past, it showed us, by contrast, the marvellous progress that has taken place in but three generations. The history is, moreover, one upon which Englishmen may look back with unalloyed pride, for in no branch of mechanical engineering do we owe less to the invention of foreigners than in that appertaining to railways, and we may justly claim that in no part of the world have railways reached such perfection as in this, nor have locomotives more beautiful in design, better fitted for the conditions of their employment and better maintained, been produced. Not only in the great works belonging to the railway companies, but in the works of private builders whose names have spread to every corner of the world, we have always had designers of superlative merit and mechanics of unsurpassed skill. We are proud to say that it is to-day, as it has always been, and that the British locomotive continues to enjoy its deserved eminence. It is not as great as the locomotives of America, it is not as complex as those of France, but in its complete economic fitness it stands unrivalled. And it does not, as misinformed people sometimes assert, stand still. It is progressing by sure steps. Mr. Collett and Mr. Maunsell have both secured a thermal efficiency of over eight per cent. without any radical departure from accepted principles, but by careful attention to design and by the encouragement of the proper method of driving, Mr. Maunsell is carrying on the practice of the late Dugald Drummond in insisting upon the full open regulator, and with what good results may be seen by the figures tabulated by Mr. Holcroft in a remarkable article printed in our penultimate issue of the year. Sir Henry Fowler is at the moment the one staunch believer in the compound system for British railways and is attaining with his Smith-Deeley compounds, of which he ordered during the year a large number, results of which we hope to hear more from him himself before next year has run its course. He is to be congratulated upon his appointment as C.M.E. of the London, Midland and Scottish Railway on the retirement of that very able locomotive engineer, Mr. George Hughes. The last to be mentioned of the four great C.M.E.'s is Mr. Gresley. He showed himself the protagonist of the big engine by the completion of the two most notable British locomotives of the year, a two-three Garratt and a three-cylinder Mikado. We hear it rumoured that in the present year he will show us further progress in locomotive design and are ready to believe it. Very high pressure locomotives are being tried in the United States and in Germany, and we shall rejoice to see them tested in this country. We have but one quarrel with these four engineers. Not one of them seems disposed to give that attention to the internal combustion locomotive which we are convinced it deserves. The oil-engined locomotive will come; of that there is no doubt. It would be a deplorable thing if this country should find itself obliged to rely upon foreign designs. Experiments are costly, but so vast a sum stands to be saved by present expense that we would once more urge upon the four railway companies the expediency of allotting between them a sufficient sum for trials and investigations. The attempts to produce a satisfactory turbine locomotive have been left to the enterprise of private builders, the North British Locomotive Company, Ltd., and Beyer, Peacock and Co., Ltd., but private builders cannot continue, in the present circumstances, to bear the load of costly experiments, and they have a right to look to the railways who would benefit by their success for support and assistance.

The Aeroplane and the Car.

In two other means of transport the year has a good deal to its credit. The aeroplane continued to make distinct progress, and, if we may venture to say so without offence to the patient workers who carried it with astonishing success through its infancy, is becoming an engineer's job. We give on another page a very full account of the progress that was made, and we invite our readers to note that, whatever pessimists may say, British progress in design and manufacture is at least the equal of that of other countries. In the field of road locomotion the establishment of the four-wheel drive for heavy vehicles may be regarded as the event of the year. The success of vehicles so fitted, and particularly of the Hathi tractors made by Thornycrofts for the War Office, leave little or no doubt that lorries, char-à-bancs and omnibuses with four driving wheels will be common in the not distant future.

Civil Engineering.

When we turn from mechanical to civil engineering we find that the completion of two very notable works add lustre to the name of British engineers; we refer, of course, to the Sennar Dam and the vast Littleton reservoir. With both of these great undertakings we deal at some length in another place, and it is unnecessary that we should do more than mention them here; but we would invite our readers to remember that both of them were conceived and executed by British engineers. Of another subject proper to civil engineering we must take this occasion to break a silence we have long held. An event of the year that agitated engineers no less than architects was the failure of Waterloo Bridge. In the spring of 1924 it became evident that the slow subsidence of the central piers, which had been going on for years, was accelerating with dangerous rapidity. It was so pronounced that it could be seen with the naked eye, and the bridge had to be closed for a time whilst it was relieved of a great deal of its superincumbent weight. As expert examination showed that it was out of the question to effect repairs, a temporary steel bridge was ordered and was erected by Sir William Arrol and Co., Ltd., with great expedition. It was opened for use early in August last, and a general view of it may be seen in one of the Supplements which we print to-day. It was fully described in our issue of June 26th. The failure of the famous bridge started a heated debate which even now is not at an end. Everyone is agreed that no bridge across the London river can compare in grandeur with Rennie's famous structure. It is not only noble in itself, but it is so harmonious with Somerset House that, taken together, they form a prospect which not London lovers alone, but architects and engineers of all countries, who appreciate the dignity that is becoming in great civic erections, give it unstinted praise. Moreover, it has sentimental associations which cannot be lightly set aside even by a cynical age. We cannot forget that it bears a name which is immortal in the ears of Britons all over the world, and we cannot flatter ourselves that any structure which may replace it and bear the same title will ever be to us what it, opened as it was at a moment when the fears and anxieties which had agitated this island for many years had at length been dispersed, has been for more than a century. In these circumstances it is not surprising that a fierce fight has raged and is still raging between those who would sweep the bridge wholly away and those who desire to see it restored. With the contention that the bridge is no longer fit for its purpose we find ourselves in little sympathy. The object of those who would pull it down is to put up a wider structure, and it is commonly said that the London County Council desires to run tramways across it. Such a course, we are convinced, would add further to the difficulties of London traffic by making still greater concentration upon an already congested centre. That the connection between the right and left banks of the river is inadequate is admitted, but it should be increased, not by the widening of a bridge at an already overburdened centre, but by the building of one at another point so that concentration of traffic may be minimised. With the provision of a new bridge elsewhere Waterloo would remain amply wide for all the traffic that can be accommodated at the Strand end, and the retention of the famous structure would be made possible. Even at this late hour, when the London County Council has decided upon its destruction, we cherish a hope that a course more consonant with the feelings of all who have the sensibility to appreciate the artistic merit of Rennie's bridge and its absolute fitness with its surroundings, may prevail, and that the bridge may be restored with no material alterations to its appearance.

Education.

Let us now consider very briefly a few subjects of general interest. Amongst them we must place the education of engineers in the first place. It is now more than a year since we spoke in these columns of the need of a revision of a system which has prevailed for nearly two decades. In the interval that has passed our views have received increasing support, and on several occasions eminent speakers have referred to the deficiencies of the present method. Indeed, there can be little or no doubt that our technical colleges, and perhaps particularly those of university status, are not fully meeting the requirements of industry, and are turning out a type of man who is not trained in just the way that fits him best for an engineering career. This conviction gained such force that in June a conference of various educational bodies met under the chairmanship of Lord Emmott to consider the possibility of instituting an inquiry into the relationship between technical education and industry. It was then decided to make some preliminary steps towards that end, and it seemed to be obvious at the time that only the position of secondary and technical schools would be considered, the question of the colleges of university rank being left to one side. However, when the conference met again a few weeks ago to confirm the decision to form a committee to carry out the inquiry, it was soon clear that the scope had been enlarged, and that the intention now is to cover the whole field of technical education. The inquiry will certainly be prolonged, and it is improbable that any report will be made for many months, but it is satisfactory to know that after an interval of many years the subject is once more to receive attention. The actual course that the investigation will take is as yet a little indefinite, but we venture to hope that the greater Institutions may be invited to give direct help, particularly with regard to the efficiency of college training.

Industry.

The year was one of quite exceptional industrial peace in the engineering trades. There was not a single great strike, and a disposition to discuss rather than to fight was manifest. For many months two conferences were continued at intervals, one concerned with the demand of the engineering unions for an increase of wages, and the other with labour conditions in shipyards. The former has, so far, led to no result one way or the other. Engineering employers have not succeeded in securing an increase of working hours, and the unions have not succeeded in their demand for a twenty shillings increase of wages. The matter came virtually to an end in the middle of November when a deputation composed of representatives of both parties waited upon the Minister of Labour to urge the observance of a clause in the Versailles Treaty, which recognised the desirability of an international forty-eight-hour week. The Minister promised to take the question up with other nations. As no report has been made as to the success of his endeavours, we may assume that no decision has yet been reached. The shipbuilding trades inquiry sprang out of the notorious Furness-Withy contract. It was carried on for nine months without any display of acrimony, but with reasonableness on both sides. In August an interim report was prepared and was issued a few weeks later. It laid particular stress upon the serious effect upon the cost of shipbuilding that was caused by lost time and by demarcation problems. In December a further step was taken when an agreement designed to prevent strikes was drawn up and submitted by the trades unions to their members with a recommendation that it should be accepted. A certain amount of opposition is being displayed, but as far as can be seen at the moment it is probable that the ballot will decide in its favour. Another event of the greatest importance in the labour world was the opening of a court of inquiry on the coal-mining industry. It sat during the later months of the year and heard a great deal of considered evidence from individuals and representative bodies. It is hoped that the court will be able to issue a report before April.

Conclusion.

It is natural when looking backwards to ask ourselves what of the future. Does the immediate past throw any light upon the year to come? We believe it does. It is not only a desire to see prosperity return to the engineering industry which puts a tinge of rose into our spectacles. The evidence of a change for the better may not yet have reached that point where it may be exhibited by statistics. Yet there is no question that a more buoyant and happy feeling prevails amongst manufacturing engineers. Inquiries are becoming

firmer, order books are filling up, and a more hopeful prospect opens. There is at the moment no reason why the promise of the future should prove false. The Government is stable and moderate, and appreciates the need of reducing taxation and assisting industry; labour, taken as a whole, is more reasonable than at any time since the war; markets in all parts of the world are ready for development; and British engineers, with enlarged workshops and plentiful equipment, are in a position to undertake more work than ever. Some disaster, some act of crass folly, may bring down the prospects in ruins, but, lacking either of them, there is every reason to anticipate that the present year will see industry well launched upon the upward side of the wave of prosperity.

Motor Ships and Marine Oil Engines in 1925.

THE past year, which began with the maiden voyage of the Aorangi and ended with the handing over of the Gripsholm and the completion of the Asturias, not only saw the definite arrival of the large motor passenger liner, but it also held much of interest to the designer of marine oil engines and the motor ship builder. In spite of the world depression in shipbuilding, in which Great Britain fully shared, our leading position as motor shipbuilders was more than held. Technical advance and greater standardisation in the construction of hulls and machinery proceeded side by side, with the result that the position of this most important industry was improved and strengthened. The actual number of ships which were built and engined in British yards differed little from that of last year, but the gross tonnage and the total horse-power of the propelling machinery was increased. In accordance with our usual practice in recent years we have tabulated the returns of builders and engine makers regarding motor ships completed within the year, and in the following table a summary of the figures for the years 1920–1925 is given :—

TABLE I.—*Vessels of 1000 Gross Tons and Upwards Fitted with Marine Oil Engines and Completed in Great Britain and Ireland during the Years* 1920–1925 *inclusive.*

Year	1920	1921	1922	1923	1924	1925
Number of motor ships completed	7	15	17	14	43	44
Total gross tons	53,407	83,980	114,527	78,862	231,764	282,325
Total I.H.P. of propelling machinery ..	31,140	42,860	69,820	49,137	145,139	180,125

In Table II. on page 18 we give particulars of the hulls and the machinery for the forty-four ships which were constructed. Apart from the two notable passenger liners, some interesting types of cargo carriers and tankers were completed, and it is not without importance that some of the orders were received from firms abroad, particularly Scandinavia. The majority of the new ships, however, will take up service on British and colonial trade routes. Two ships, the Elmworth and Oakworth, were completed late in 1924, but as they were not included in last year's returns, we have added them to the list given in Table II., making our record complete.

In looking over that table a definite tendency towards the evolution of standard types of hulls and propelling machinery can be seen. That tendency when further developed should assist in removing the present difference in cost—say, 15 to 20 per cent.—between a motor ship and a vessel of similar size and type propelled by steam engines. Referring to the cost of motor ships, we may recall the consternation which was felt throughout the industry and the country at large when early in March it was announced that an order for five 440ft. motor ships of 10,000 tons deadweight carrying capacity for the Prince Line had been placed by Furness, Withy and Co., Ltd., with the Deutsche Werft, of Hamburg. The difference in price between the lowest British tender and the German offer was £60,000 per ship, an amount which was difficult to explain, even after making allowance for increased standardisation, longer working hours, lower wages, rates and taxes, freedom from demarcation troubles, and other conditions incidental to the then German shipyard practice. The fact that when asked to tender for two slightly larger ships for the British Molasses Company, Ltd., the same firm of builders quoted a higher price than did British yards, seemed to indicate that the previous price was on the low side. At any rate, the incident had the effect of calling together a joint conference of representatives of the Shipbuilding Employers' Federation and the unions of the shipyard workers. The first part of the inquiry was concluded and the report upon it formed the subject of a leading article in our issue of October 23rd. A further investigation into outside costs and their effect on the shipbuilding industry is now being undertaken. Whatever be the results of this inquiry, and how far the report regarding demarcation and labour conditions will be applied, cannot yet be determined, but it may be confidently stated that in the year that is past British shipbuilders succeeded in reducing their costs of production, and improving the organisation of their yards, so that they are now in a much better position to cope with foreign competition.

Double-acting Engines.

One of the most important developments of the year took place in connection with double-acting engines. Engines of this pattern are now built both on the four-stroke and two-stroke principle, and various units aggregating over 200,000 brake horse-power are under construction. We shall deal first with the four-cycle double-acting engine of the Burmeister and Wain type. Some knowledge of this new type of prime mover was gained from a paper by Mr. H. H. Blache given before the Institution of Engineers and Shipbuilders, which was published in THE ENGINEER of February 27th. The two first engines built to this design were for the Swedish-American liner Gripsholm—illustrated in one of to-day's Supplements. Their completion was somewhat delayed by labour troubles, but trials were run towards the end of November. The machinery of this ship was fully described in our issues of December 4th and 11th. Each of the twin engines has six $33^1/_{16}$in. bore cylinders, with a stroke of $59^1/_{16}$in., designed for an output of 7250 brake horse-power at a speed of 125 revolutions per minute. The compressors are separately driven by auxiliary Diesel engines. Satisfactory trials were carried out, but it was deemed advisable to modify the propellers slightly in order to allow full engine power to be developed at a somewhat lower speed of revolution. The Gripsholm left Gothenburg on November 21st and arrived in New York on the 30th, after a non-stop run, the engines developing 15,740 mean indicated horse-power at 116 revolutions per minute. It is reported that vibration was practically non-existent. Two other engines of this type—one of which we illustrate on page 14—were completed by Harland and Wolff for the Royal Mail Steam Packet Company's 20,500-ton passenger liner Asturias, which will begin her trials this month. Fig. 1 shows her during fitting out at her builder's yard in Belfast, attended by the 150-ton floating crane. Her low, broad funnels and well-raked masts give her a particularly powerful and distinctive appearance. Each of her twin-screw main engines—see page 14—is designed for a normal output of 7500 brake horse-power, or 10,000 indicated horse-power, per shaft, with eight cylinders, each $33^1/_{16}$in. diameter with a stroke of $59^1/_{16}$in. The service speed of the engines is fixed at 115 revolutions per minute. Unlike the engines of the Gripsholm, the air compressors are driven from the main crank shaft, and comprise two cylinders placed at the forward end of the engine. Engines of this type totalling some 100,000 horse-power are under construction at Belfast.

The successful trials made on the experimental single-cylinder North-Eastern-Werkspoor engine at Wallsend in 1924 were, in 1925, extended with improved valve gear, and in the autumn an eighty days' non-stop run was made, which to date is one of the longest trials ever recorded. The new type of valve gear referred to was designed by Mr. C. J. Lugt, of Werkspoor, Amsterdam, and Mr. C. Zulver, of the Anglo-Saxon Petroleum Company, Ltd., for which firm multi-cylinder, double-acting oil engines are being built at Amsterdam and at Wallsend. In the new patented valve gear a central fuel valve is employed, surrounded by six small mushroom type valves, which are made to serve alternately as exhaust and air inlet valves. The small valves are put into communication with the respective valve passages by a rotary sleeve valve, provided with ports. The rotary valve is operated by a rack and pinion driven from the control shaft. We understand that in the trial referred to this new type of gear gave excellent results. The first double-acting engine to be completed will be a set for Alfred Holt and Co., of Liverpool, which will be tested very shortly.

Following the successful installation of Richardsons-Beardmore-Tosi engines in the two vessels Sycamore and Tramore, Richardsons, Westgarth and Co., Ltd., came to the decision that single-acting engines, especially of the four-cycle type, leave much to be desired from the all-round financial standpoint of the shipowner and accordingly devoted themselves to the construction of a single-cylinder, two-cycle, double-acting engine. That engine will be tested early in the year. It has a cylinder 26½in. in diameter, with a 47½in. stroke, and is designed to develop its full power at 90 revolutions per minute.

During the past year another engine of the North British two-cycle, double-acting, sliding-cylinder type was completed and was installed in the cargo ship the City of Stockholm. Particulars of this ship are included in the table reproduced on page 18. The North British Engine Works have now been taken over by Barclay, Curle and Co., Ltd., and will form the headquarters of that company.

Other double-acting engines have been built abroad, and some reference to them will be found in those sections of this article which deal with progress made in America, Italy, and in Germany.

Single-acting Four-cycle Engines.

The place of honour as regards the largest number of four-cycle, single-acting engines constructed during the year again falls to Harland and Wolff, Ltd., which firm completed no less than twenty-seven sets of machinery of the Harland-B. and W. type. From details of these engines being given on page 18, it will be seen that included amongst them are eighteen sets of similar machinery for the Bank Line ships, along with engines of the long-stroke pattern and the new light pattern with trunk pistons. At Greenock, J. G. Kincaid and Co., Ltd., built six sets of engines of the standard Harland-B. and W. pattern, whilst at Bedford W. H. Allen, Sons and Co., Ltd., supplied several sets of auxiliary engines of this same type.

The North-Eastern Marine Engineering Company, Ltd., completed during the year a large North-Eastern-Werkspoor motor for the Raby Castle—see to-day's Supplement—a vessel built for the Lancashire Shipping Company, Ltd., by the Caledon Shipbuilding and Engineering Company, Ltd., of Dundee. A full account of this cargo ship and her machinery was given in THE ENGINEER of April 24th. Two other Hawthorn, Leslie-Werkspoor engines will be installed in a tanker which was launched at Lithgows, Ltd., of Port-Glasgow.

At Dalmuir no ships were engined with Beardmore-Tosi engines, but we understand that several auxiliary units for naval use were completed.

Single-acting Two-cycle Engines.

The first place among engines of the two-cycle, single-acting type falls again to the Sulzer type of motor, for during the year no less than 141 engines, representing a total output of about 150,000 brake horse-power, were built by Sulzer Bros., of Winterthur, its associated companies and licensees. An outstanding ship of the year was the Aorangi, described in the first four issues of 1925. Her running experience throughout the year was, we are given to understand, satisfactory. The Fairfield Shipbuilding and Engineering Company, Ltd., also completed the Houlder Line refrigerator ship Upwey Grange, which was described in our issue of December 18th and is illustrated in one of to-day's Supplements. Other Sulzer engined vessels were built by Sir W. G. Armstrong, Whitworth and Co., Ltd., and John Brown and Co., Ltd.—see page 18. In the last weeks of

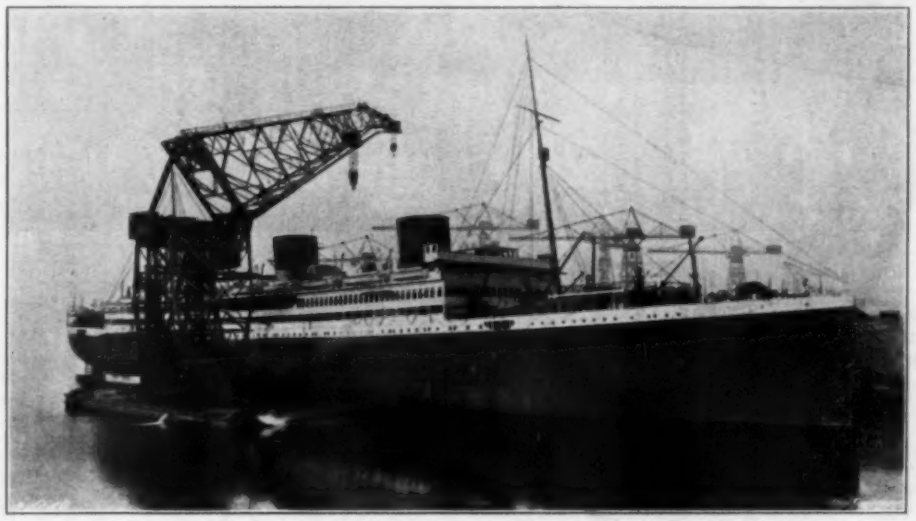


FIG. 1—R.M.S.P. MOTOR PASSENGER LINER ASTURIAS

SOME BRITISH MOTOR SHIPS AND MARINE OIL ENGINES OF 1925

TABLE II.

Name of vessel.	Type.	Hull particulars.				Builders.	Owners.	Type of propelling machinery.	Main engine particulars.					Auxiliary machinery.
		Length B.P.	Breadth m'lded.	Depth m'lded.	Gross Tons.				Bore.	Stroke.	R.p.m.	Total I.H.P.	Total B.H.P.	
		Feet.	Feet.	Feet.					Inches.	Inches.				
Asturias	Passenger liner	630	78	45	22,500	Harland and Wolff, Ltd.	Royal Mail Steam Packet Co.	Twin-screw, double-acting, eight-cylinder, four-cycle, Harland and Wolff-B. and W. type	33 1/16	59 1/16	115	20,000	15,000	Diesel-electric, four 400-K.W. and one 75-K.W. Harland and Wolff generating sets
Alynbank, Clydebank, Elmbank, Forresbank, Larchbank, Lovenbank, Myrtlebank, Nairnbank, Weirbank (nine ships)	Cargo ships	434	53·75	37	5,200	Harland and Wolff, Ltd.	Bank Line (Andrew Weir and Co.)	Twin-screw, single-acting, six-cylinder, four-cycle, Harland and Wolff-B. and W. type	24 11/16	37 11/16	125	3,100	2,300	Diesel-electric engine-room auxiliaries, two 65-K.W. Harland and Wolff, generating sets, steam winches
Athelchief	Molasses tanker	460	59	33	7,550	Caledon Shipbuilding and Engineering Co., Ltd., and J. G. Kincaid and Co., Ltd.	British Molasses Co., Ltd.	Twin-screw, single-acting, six-cylinder, four-cycle, Kincaid-Harland-B. and W. type	24 11/16	51 1/16	110	3,850	2,850	Steam-driven auxiliaries
Athelprince	Molasses tanker	470	62·25	35·3	8,875	Furness Shipbuilding Co., Ltd., and J. and G. Kincaid and Co., Ltd.	British Molasses Co., Ltd.	Twin-screw, single-acting, six-cylinder, four-cycle, Kincaid-Harland-B. and W. type	24 11/16	51 1/16	110	3,850	2,850	Steam-driven auxiliaries
Atlantic	Tanker	440	57·5	34	7,342	Sir W. G. Armstrong, Whitworth and Co., Ltd.	Atlantic Steamship Co., Bergen	Twin-screw, single-acting, six-cylinder, two-cycle, Armstrong-Sulzer	23½	41½	110	2,750	2,250	Steam-driven auxiliaries, two 25-K.W. electric generating sets
Belnor	Locomotive carrier	308	46·3	19·75	2,750	Sir W. G. Armstrong, Whitworth and Co., Ltd.	Christen Smith's Rederi, Oslo	Single-screw, single-acting, four-cylinder, two-cycle, Armstrong-Sulzer type	23½	41½	110	1,875	1,350	Steam and Diesel-electric auxiliaries, two 35-K.W. M.A.N. generating sets
British Chemist	Tanker	440	57	33·8	6,998	Palmer's Shipbuilding and Iron Co., Ltd.	British Tanker Co., Ltd.	Single-screw, single-acting, six-cylinder, Palmer-Camellaird-Fullagar type	23	2×36	90	3,750	3,000	Steam and Diesel-electric auxiliaries, two 60-K.W. Weir-Sulzer generating sets
British Petrol	Tanker	454	57	27	6,906	Swan, Hunter and Wigham Richardson, Ltd.	British Tanker Co., Ltd.	Single-screw, single-acting, eight-cylinder, two-cycle Neptune type	24	50	80	4,000	3,200	Steam and Diesel-electric auxiliaries, two 60-K.W. Atlas generating sets
Cape of Good Hope	Cargo ship	404	52	30	4,700	Lithgow's Ltd., and J. G. Kincaid and Co., Ltd.	Lyle Shipping Co., Ltd.	Single-screw, single-acting, six-cylinder, four-cycle, long-stroke, Kincaid-B. and W. type	29½	59 1/16	98	2,500	2,000	Diesel-electric auxiliaries, two 65-K.W. Allen-B. and W. generating sets
City of Stockholm	Cargo ship	410	55·25	29	5,075	Barclay, Curle and Co., Ltd.	Ellerman Hall Lines, Ltd.	Single-screw, double-acting, three-cylinder, opposed-piston, North British sliding cylinder type	24	2×44	96	2,700	2,000	Steam and Diesel-electric auxiliaries
Elmworth and Oakworth (two ships)	Cargo ships	400·1	53·2	26·9	4,966	Arch. MacMillan and Co., Ltd., and Harland and Wolff, Ltd.	Dalgleish Steam Shipping Co.	Single-screw, single-acting, six-cylinder, four-cycle, long-stroke, Harland-B. and W. type	29½	59 1/16	90	2,250	1,850	Diesel-electric auxiliaries
Enton	Cargo ship	375	52·5	28·25	4,425	Furness Shipbuilding Co., Ltd., and Wallsend Slipway and Engineering Co., Ltd.	Avenue Steamship Co., Ltd.	Single-screw, single-acting, four-cylinder, two-cycle, Wallsend-Sulzer type	26 13/16	47½	90	2,250	1,800	Steam-driven deck and engine-room auxiliaries
Gascony	Cargo ship	385	53	28	4,716	Arch. MacMillan and Co., Ltd., and Harland and Wolff, Ltd.	D. MacIver and Co., Ltd.	Single-screw, single-acting, eight-cylinder, four-cycle, long-stroke, Harland-B. and W. type	29½	59 1/16	88	3,100	2,500	Diesel-electric, three 100-K.W. Harland and Wolff generating sets
Gripsholm	Passenger liner	574·5	74	76·5	17,300	Sir W. G. Armstrong, Whitworth and Co., Ltd., and Burmeister and Wain	Swedish American Line (Axel Broström and Son)	Twin-screw, double-acting, six-cylinder, four-cycle, Burmeister and Wain type	33 1/16	59 1/16	125	16,300	13,500	Diesel-electric, three 330-K.W. Burmeister and Wain generating sets and three Diesel-compressor sets
King James and King Malcolm (two ships)	Cargo ships	400·3	59	25·9	5,200	D. and W. Henderson, Ltd., and Harland and Wolff, Ltd.	British Motor Ship Co., Ltd.	Single-screw, single-acting, six-cylinder, four-cycle, long-stroke, Harland-B. and W. type	29½	59 1/16	90	2,250	1,850	Diesel-electric auxiliaries
O. A. Knudsen	Tanker	470	62·25	34·75	9,025	Blythswood Shipbuilding Co., Ltd., and J. G. Kincaid and Co., Ltd.	Jannette Skinner Steamship Co., Haugesund	Twin-screw, single-acting, six-cylinder, four-cycle, longstroke Kincaid-Harland-B. and W. type	24 13/16	59 1/16	111	4,000	3,000	Diesel-electric auxiliary machinery
Limerick	Cargo ship	460	62·5	37·75	9,000	William Hamilton and Co., Ltd., and John Brown and Co., Ltd.	Union Steamship Co., Ltd., of New Zealand	Twin-screw, single-acting, six-cylinder, two-cycle, Brown-Sulzer type	26 13/16	47½	100	7,500	6,000	Steam-driven auxiliaries
Lumen	Tanker	420	54·25	32·7	6,500	John Brown and Co., Ltd.	H. E. Moss and Co. Tankers, Ltd.	Twin-screw, single-acting, four-cylinder, two-cycle, Brown-Sulzer type	23½	41½	110	3,400	2,700	Steam-driven deck and engine-room auxiliaries
Madrid and Roma (two ships)	Cargo ships	275	42·1	12·5	1,453	A. and J. Inglis and Harland and Wolff, Ltd.	Argentine Navigation Co., Ltd.	Twin-screw, single-acting, six-cylinder, four-cycle, trunk-piston, Harland-B. and W. type	15½	29½	155	1,250	900	Diesel-electric auxiliaries, two 55-K.W. generating sets
Malabar	Passenger and cargo ship	350	48·5	25·25	4,512	Barclay, Curle and Co., Ltd., and J. G. Kincaid and Co., Ltd.	Burns Philp and Co., Ltd., Sydney	Single-screw, single-acting, eight-cylinder, four-cycle, long-stroke, Kincaid-Harland-B. and W. type	29½	59 1/16	100	3,800	2,700	Diesel-electric, four 100-K.W. Allen-B. and W. generating sets
Neptunian	Cargo ship	400	53·25	29·3	5,075	Swan, Hunter and Wigham Richardson, Ltd.	T. H. Skogland and Son, Haugesund	Single-screw, single-acting, six-cylinder, two-cycle, Neptune type	22½	45	100	3,200	2,250	Diesel-electric auxiliaries, two 65-K.W. Atlas generating sets
Otokia	Tanker	437·75	57	33·75	7,270	Livingstone and Cooper, Ltd., and Sulzer Bros.	Union Steamship Co., Ltd., of New Zealand	Twin-screw, single-acting, four-cylinder, two-cycle, Sulzer type	23½	41½	110	3,750	3,000	Steam-driven deck and engine-room auxiliaries
Peisander	Cargo and passenger ship	425	54·5	32·75	6,224	Caledon Shipbuilding and Engineering Co., Ltd., and Burmeister and Wain	Ocean Steamship Co. (Alfred Holt and Co.)	Twin-screw, single-acting, eight-cylinder, four-cycle, Burmeister and Wain type	24 13/16	43 3/16	125	4,800	3,700	Diesel-electric, four 100 K.W. Burmeister and Wain generating sets
Prometheus and Alcinous (two ships)	Cargo and passenger ships	425	54·5	32·75	6,372	Scott's Shipbuilding and Engineering Co., Ltd., and Burmeister and Wain	Ocean Steamship Co. (Alfred Holt and Co.)	Twin-screw, single-acting, eight-cylinder, four-cycle, Burmeister and Wain type	24 13/16	43 3/16	125	4,800	3,700	Diesel-electric, four 100-K.W. Burmeister and Wain generating sets
Port Dunedin	Refrigerator cargo ship	463	59·75	43·75	7,463	Workman, Clark and Co., Ltd., and William Doxford and Sons, Ltd.	Commonwealth and Dominion Line, Ltd.	Twin-screw, single-acting, four-cylinder, two-cycle, opposed-piston, Doxford type	21½	2×42½	95	5,500	4,840	Diesel-electric, three 210-K.W. Allen-B. and W. generating sets
Port Hobart	Refrigerator cargo ship	463	59·75	43·75	7,448	Swan, Hunter and Wigham Richardson, Ltd., and William Doxford and Sons, Ltd.	Commonwealth and Dominion Line, Ltd.	Twin-screw, single-acting, four-cylinder, two-cycle, opposed-piston, Doxford type	21½	2×42½	95	5,500	4,840	Diesel-electric, three 210-K.W. Allen-B. and W. generating sets
Raby Castle	Cargo ship	412·75	52·25	37	4,900	Caledon Shipbuilding and Engineering Co., Ltd., and North-Eastern Marine Engineering Co., Ltd.	Lancashire Shipping Co., Ltd. (James Chambers and Co.)	Single-screw, single-acting, eight-cylinder, four-cycle, North-Eastern-Werkspoor type	28½	51 3/16	92	3,000	2,200	Diesel-electric, two 100-K.W. and one 65-K.W. Werkspoor generating sets
Silveray	Light cargo ship	395	57	25·8	4,535	J. L. Thompson and Sons, Ltd., and William Doxford and Sons, Ltd.	Silver Line, Ltd.	Single-screw, single-acting, three-cylinder, two-cycle, opposed-piston, Doxford type	22½	2×45½	90	2,600	2,200	Diesel-electric, three 65-K.W. Allen-B. and W. generating sets
Storstad	Tanker	469	62	34·7	9,000	Blythswood Shipbuilding Co., Ltd., and J. G. Kincaid and Co., Ltd.	A. F. Klaveness and Co., Oslo	Twin-screw, single-acting, six-cylinder, four-cycle, longstroke Kincaid-Harland-B. and W. type	24 13/16	51 3/16	111	4,000	3,000	Diesel-electric auxiliaries, 100-K.W. generating set
Sylvafield	Cargo ship	395	51·75	31·75	5,709	Sir James Laing and Sons, Ltd., and William Doxford and Sons, Ltd.	Hunting and Son	Single-screw, single-acting, four-cylinder, two-cycle, opposed-piston, Doxford type	22½	2×45½	75	2,900	2,550	Steam-driven deck and engine-room auxiliaries
Thistleros	Cargo ship	400	53·6	23·8	4,815	D. and W. Henderson, Ltd., and Harland and Wolff, Ltd.	Albyn Line, Ltd. (Allan Black and Co.)	Single-screw, single-acting, six-cylinder, long-stroke four-cycle, Harland and Wolff-B. and W. type	29½	59 1/16	90	2,250	1,850	Diesel-electric generating sets
Upwey Grange	Refrigerator cargo ship	430	62·3	38·25	9,130	Fairfield Shipbuilding and Engineering Co., Ltd.	Houlder Bros.	Twin-screw, single-acting, six-cylinder, two cycle, Fairfield-Sulzer type	28	39	117	8,000	6,400	Steam-driven deck and engine-room auxiliaries

the year a new type of Brown-Sulzer engine was tested—see page 14. It is the largest size of marine oil engine yet constructed in Great Britain. It has four cylinders, each 35½in. diameter, with a stroke of 63in., and was designed to develop 4000 brake horse-power at a normal speed of from 86 to 87 revolutions per minute. This designed power was obtained on the test bed trial. The unit referred to, which is complete with two three-stage air compressors and two scavenging pumps mounted at the forward end of the engine and driven from an extension of the crank shaft, will form the first half of a port set of proposed twin-screw machinery. This twin-screw installation would consist of two eight-cylinder motors designed for a total output at sea of

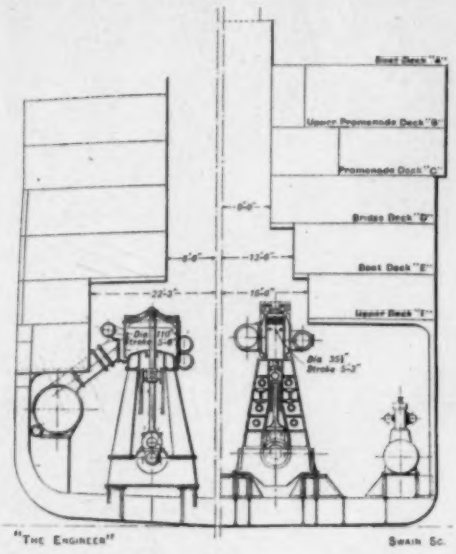


FIG. 2 STEAM AND OIL ENGINES COMPARED

15,000 brake horse-power, equal to 19,000 indicated horse-power.

In Fig. 2 we reproduce sections showing one of the proposed new engines placed side by side with the starboard set of 20,000 indicated horse-power quadruple-expansion steam engines, which were built at Clydebank for the Cunard liner Caronia and which to-day are continuing to work as satisfactorily as ever. It is interesting to note that a similar piston speed to that employed on the Caronia's engines is proposed for the new large-power Brown-Sulzer engines. The set we illustrate is of particular importance, as it brings up the power of the two-stroke, single-acting engine to that which is required for a twin-screw machinery installation for a large passenger liner. The engine we have referred to was designed and constructed by John Brown and Co., Ltd., in connection with Sulzer Bros., of Winterthur.

The firm of Mirrlees, Bickerton and Day, Ltd., has

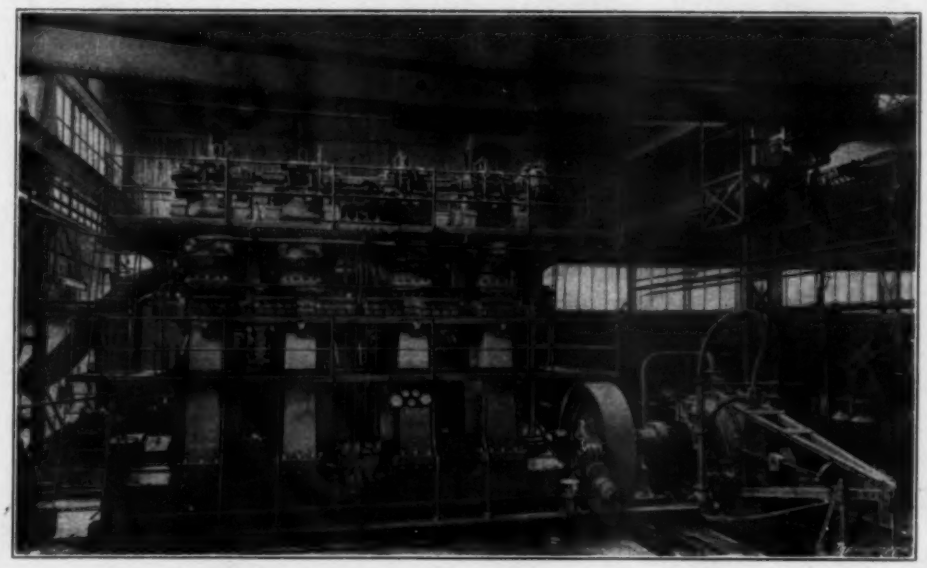


FIG. 3—MIRRLEES-NOBEL 1000 B.H.P. TWO-CYCLE ENGINE

for many years occupied a leading position as regards Diesel engines for land use, marine auxiliaries, and industrial work, and it is not surprising that during the year it turned its attention to engines of large power, which are now also available for marine work. We illustrate in Fig. 3 the new type of 1000 brake horse-power reversible Mirrlees-Nobel engine which was recently completed and tested. It embodies the long experience of the Nobel firm, but in the design have been incorporated many of the standard features of the Mirrlees engine. It is a four-cylinder model with a cylinder diameter of 22in. and a stroke of 29½in., and its designed speed is 125 revolutions per minute. With six cylinders powers up to 1500 brake horse-power can be obtained. In order to reduce the engine length the scavenging air pumps are placed behind the main columns and are link-driven, but they may equally well be placed in line with the main cylinder when space permits. The interlocked reversing controls are placed at the centre of the engine and the reversing operations from full speed ahead to full speed astern can be performed very quickly.

The "Neptune" type of marine engine built by Swan, Hunter and Wigham Richardson, Ltd., was installed in several ships, particulars of which are given on page 18.

Shortly before the end of the year we were able to visit the Blue Funnel Line motor ship Dolius and to inspect her Scott-Still propelling machinery, which throughout the year continued to operate very satisfactorily with notable absence of repairs and upkeep charges. Scott's Shipbuilding and Engineering Company, Ltd., of Greenock, has now been instructed by Alfred Holt and Co. to proceed with a second ship in which machinery of 5000 brake horse-power, or double the power of the Dolius, will be installed.

Opposed Piston Engines.

The opposed-piston engine designed and constructed by William Doxford and Co., Ltd., of Sunderland, maintained its reputation for good service and low fuel consumption, and four vessels were equipped with this type of prime mover during the year—see Table II., page 18. Towards the end of November orders were received for six more ships for the Silver Line, which order alone should keep the engine shops busy for part of the present year. At Palmer's Shipbuilding and Iron Company, Ltd., another set of Palmer Camellaird-Fullagar engines were built and were erected in the tanker British Chemist. This vessel is a sister ship to the British Aviator, which was engined with similar machinery last year.

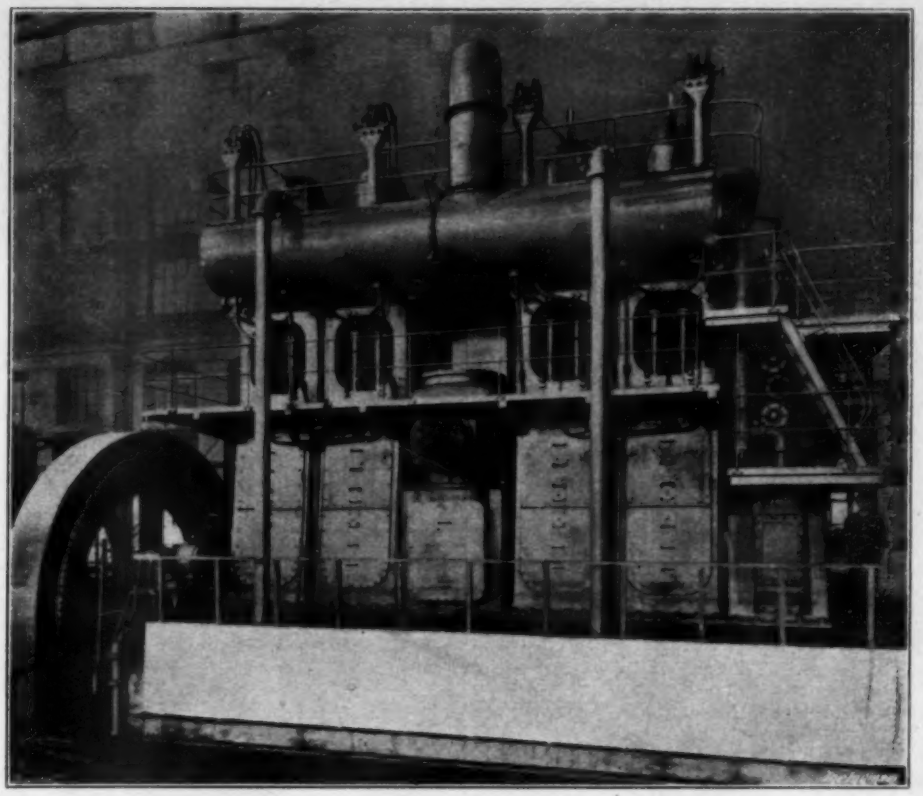


FIG. 4—WORTHINGTON 2900 B.H.P. DOUBLE-ACTING ENGINE

Motor Ships and Marine Oil Engines in America.

The building of marine oil engines in America during 1925 was largely affected by the Shipping Board policy of "Dieselization," and several ships were converted from steam to oil-engine operation. Outstanding amongst the various engines which were ordered for the conversion of steamships is the 2900 brake horse-power, four-cylinder, double-acting, two-cycle Worthington engine we illustrate in Fig. 4. It was designed and built at the Snow Holly Works of the Worthington Pump and Machinery Corporation at Buffalo and has passed satisfactory bench tests. Each of the cylinders has a bore of 28in. with a stroke of 40in. and the unit is designed to develop its full power at 90 revolutions per minute. Several new constructional features are embodied in the design, and the weight of the engine is low for its power, being about 214 lb. per brake horse-power. It is probable that this type of marine engine will eventually be built in England by Worthington-Simpson Company, Ltd. Another interesting engine was tested during the latter part of the year at the yard of the Sun Shipbuilding Company, Ltd., Chester, Pa. It is a constant-pressure engine of the Smith-Whaley type and has an output of 750 brake horse-power with a weight, it is said, of only about 33 tons; very little is known, however, of its performance. The same builders carried out several conversion jobs with Sun-Doxford engines. Among the other machinery completed and installed in America during 1925, and there were not more than for or five sets, were two installations of American-Werkspoor engines and two with Ingersoll-Rand-Price type engines with electric transmission. In the Price engine two impinging fuel sprays are employed with a water-cooled combustion head and the engine works on the four-stroke cycle. Ingersoll-Rand engines of this type are to be built at Carels' factory in Ghent, Belgium.

Continental Progress in 1925.

Although most of the developments on the Continent were to some extent reflected in British practice, some of the more interesting ships and engines built and laid down may be passed in review. In Denmark, Burmeister and Wain built eight cargo ships and two passenger ships, some of which were fitted with supercharged engines. A notable

vessel was the Parkeston for the Harwich-Esbjerg mail service of the United Steamship Company, of Copenhagen. She was described in THE ENGINEER of August 14th and August 21st. This vessel is engined with twin-screw high-speed trunk piston pattern motors and supercharging blowers are fitted. So successful has she proved that a sister ship has been ordered. Considerable interest centred, of course, around the double-acting engines built for the Swedish-American liner Gripsholm, to which we have already referred. In Sweden the Götaverken, of Gothenburg, completed five ships and a total of thirty-two engines, including auxiliaries. It is reported that the Götaverken is to construct and engine a sister ship to the Gripsholm. In Holland the Werkspoor works engined two tankers, the Nordanger and Varanger, which were built by the Netherland Shipbuilding Company, of Amsterdam. In each ship two 1800 brake horse-power motors were installed. Several sets of double-acting, four-cycle Werkspoor engines were begun for the Anglo-Saxon Petroleum Company's tankers. At the Royal "De Schelde" works at Flushing four Schelde-Sulzer motors were completed, two of which will be placed in the Rotterdam Lloyd 10,771-ton liner Indrapoera. The Fijenoord Company, of Rotterdam, completed and engined the tanker Katendrecht with a single-cylinder, four-cycle M.A.N. engine of 1850 brake horse-power. During the year arrangements were made to fit a 900 brake horse-power Burgerhout-Nobel engine into a British ship.

Considerable progress was made in Germany, and upwards of thirty motor ships were completed. They include vessels engined with standard A.E.G.-Burmeister and Wain type of engines, Krupp motors, and M.A.N. engines, both of the four-cycle, single-acting and the two-cycle, double-acting types. We are given to understand that above 1800 brake horse-power the double-acting, two-cycle motor presents advantageous features both as regards size and cost. Already one vessel, the Altmark, has been fitted with a three-cylinder engine of this type with $27^{9}/_{16}$in. cylinders and a stroke of 47½in., designed to develop 2000 brake horse-power at 78 revolutions per minute. Over ten engines of this type are under construction, two six-cylinder units of 4000 and 4400 brake horse-power capacity respectively having been completed. A high-powered engine of the same type is the 15,000 brake horse-power nine-cylinder unit with a bore of $33^{13}/_{16}$in. and a stroke of 47½in., which Blohm and Voss, of Hamburg, has completed for the Hamburg electricity works. An interesting German ship of the year was the Duisburg, which was built by Vulcan, of Hamburg, for the German-Australian and Kosmos Lines. She is a 448ft. cargo ship with a deadweight carrying capacity of about 9000 tons and is fitted with twin-screw, four-cycle M.A.N. motors designed for an output of 4000 shaft horse-power at a speed of 210 revolutions per minute. This engine speed is reduced to a normal propeller speed of 79 revolutions by a hydraulic coupling and mechanical reduction gear. Such an arrangement is claimed to give considerable flexibility, quick reversing and a transmission efficiency of about 97.5 per cent. At the meetings of the German Institution of Naval Architects, which were held in Hamburg in November, Dr. Bauer gave an interesting paper on the hydro-mechanical drive, in which the results obtained from the Duisberg and her sister ship, the Altenfels, were discussed. Incidentally it may be mentioned that the new Beardmore-Tosi double-acting engine will be tested along with a transmission drive of this type. Other developments in Germany during the past year included experiments with superchargers and outputs of engines have been increased from 10 to 20 per cent. by the employment of such means.

Probably there is no country to-day which is further advanced in its programme of motor ship construction than is Italy. In all about seven Italian motor ships were completed during 1925, and they include two large passenger ships. Engines of the Tosi type, Fiat motors and Italian-built Burmeister and Wain type motors were constructed. Indeed the shops of the Stabilimento Tecnico Triestino are particularly well equipped for the production of standard type B. and W. engines. At this yard the large Consulich liners for service between Naples and New York are being constructed. The Saturnia and Urania, for so these liners are named, will have a length of about 630ft. with a breadth of 79ft. 6in. and a depth of 45ft. Their gross tonnage will be about 23,500 tons and the total shaft horse-power 18,000. Supercharging blowers are to be employed. The vessels are to be funnelless and runways are to be provided to carry four seaplanes, which will be used experimentally at first to save time on the voyage for both passengers and special mails. At the Fiat works in Turin a new type of two-cycle, single-acting engine was built and in its construction cast steel was largely employed. It is also understood that a large double-acting, two-cycle engine of 2000 brake horse-power per cylinder is under construction at these works. During the year an order was placed by the Navigazione Generale Italiana, of Genoa, for a 30,000 gross ton motor passenger liner Augustus, which will be built at the Ansaldo, Sestri Ponenti Yard, Genoa. This vessel, which, when completed, will be the largest motor liner in the world, will have four M.A.N. type double-acting, two-cycle engines. Each engine is to give 6250 brake horse-power continuous output at 120 revolutions per minute and will be a six-cylinder unit with $27^{9}/_{16}$in. bore cylinders and a stroke of 47½in. The total shaft horse-power will thus be at normal speed 25,000 or 28,000 maximum, at 125 revolutions per minute. The scavenging blowers and electric generators, aggregating 4750 brake horse-power, will be installed in a separate auxiliary engine-room. The hull of the ship is practically identical with that of the steam turbine vessel Roma, now under construction at the Ansaldo yard.

Conclusion.

From the necessarily short review of the progress made in 1925 in motor ship building and the marine oil engine industry it will be seen that considerable development took place. Whereas early in 1924 the largest size of cylinder built—apart from single-cylinder experimental engines—was only 29in. or 30in., last year, cylinders of 33in. and 35½in. were built and tested in actual engines. This means that engines of double the horse-power per shaft that was attainable two years ago can now be installed, and there is practically no limit to the field of application of the marine oil engine. The past year saw new types of engines evolved and improvements made to auxiliary plant and we are in no doubt that the motor ship will prove perhaps the most important factor in the revival of the British shipbuilding industry.

Electrical Engineering in 1925.

No. I.

To deal with twelve months' progress in electrical engineering in an article of reasonable length has long ceased to be a simple and straightforward undertaking. Years ago it was possible to give in a few columns of THE ENGINEER a fairly comprehensive outline of the principal work carried out and the technical progress made in this country and elsewhere, but in these days it is quite out of the question to give an adequate idea of the work done, even by the British manufacturers, in the space we have to spare. How impossible it is to consider, in detail, progress abroad without exceeding the space limit imposed, can be gauged from the fact that one American firm alone, namely, the Westinghouse Electric and Manufacturing Company, has just issued a forty-page book on its achievements during 1925. In it we find particulars of some rather abnormal electric locomotives and machines, such, for instance, as a 40,000-kilowatt frequency changer and a synchronous condenser of the same capacity. With American progress, however, we cannot deal or, indeed, with all the progress in the United Kingdom. We scarcely need refer, especially in view of the recent publication of the Electricity Commissioners' fifth annual report, to recent extensions to existing stations or to new stations, the most notable being, of course, the Barking station opened by the King in May. Judging from the information sent to us by various electrical firms, the electrical manufacturing industry as a whole did a very fair amount of business, and important orders were received from abroad.

Wireless Communication.

As far as technical developments are concerned, wireless communication easily beats all other branches of electrical engineering. Not very long ago it was thought that short waves were quite unsuitable for long-distance transmission, and amateurs were permitted to make use of them because it was thought that they were of very little value for commercial purposes. But it has now been discovered that very great distances can be covered with these short waves, and with the use of quite small powers. The Austin-Cohen formula, which shows that the rate of attenuation increases very rapidly during daylight as the wave length is reduced, has been proved by Mr. Marconi's investigations to be very much at fault. With suitable wave lengths below about 25 m. Mr. Marconi has found that signals received over long distances are even stronger by day than they are by night. With wave lengths between 12 m. and 30 m. he has, in fact, established communication with Australia and the Argentine during the whole twenty-four hours, with only a small fraction of the power required by the ordinary long-wave stations that are employed for commercial transmissions over such a comparatively short distance as 1000 miles. But much data have yet to be collected to enable wireless engineers to determine the most efficient wave length to employ and the minimum amount of power required for a particular service. Sufficient information is, however, available to enable the Marconi Company to say that the commercial success of the new beam stations in the course of erection in this country and in our Dominions overseas is assured. What cannot be determined at the moment is to what extent the latent possibilities for high-speed traffic working on the short-wave system can be realised. Employing an experimental plant, which, except for its power, represents in all respects the working conditions of a commercial equipment, the Marconi Company's engineers have obtained speeds up to 3000 words per minute. The various incidental problems of handling traffic at high speeds have been tackled, and to a large extent satisfactorily solved. Apart from the enormously increased traffic carrying capacity of these new installations, high-speed signalling speeds will bring the transmission of photographs by wireless within commercial reach. Recent experiments between New York and London showed that the obstacle to the commercial development of the wireless transmission of photographs was the fact that it took twenty minutes to send a single picture about 4in. square, thus making the transmission unduly expensive. The time taken to send a picture is, of course, governed by the signalling capacity of the sending and receiving stations, which, in the case mentioned was approximately 100 words per minute. But if signalling speeds of 3000 words per minute could be obtained, the time required to send the same picture would be less than a minute, and it is therefore possible that an entirely new service of daily Press photographs of topical interest may be created in the near future.

FIG. 1—WIRELESS TRANSMITTING GEAR AT DAVENTRY, MODULATOR PANELS IN FOREGROUND

Broadcasting developments took place mainly along the lines of the construction and use of high-power transmitters. At the Daventry station a 35 to 50 Marconi transmitter, as shown in Fig. 1, is now in use, and greatly increased radiation power has been obtained without sacrificing the quality of signals. The effective range of a broadcast transmitter depends as much upon the degree of modulation impressed on the carrier wave as upon the actual power radiated, and in the latest transmitters developed by the Marconi Company modulation has been substantially increased without the introduction of distortion or blasting. The average degree of modulation of the transmitters is now about 20 per cent. higher than that obtained previously. The Birmingham station of the British Broadcasting Company was reconstructed by Standard Telephones and Cables, Ltd. (formerly the Western Electric Company), and it now has a capacity of 1 kilowatt. At Prague the same company erected a 5-kilowatt station and a 1-kilowatt station

at Milan. An important and highly interesting development from the point of view of the application of wireless to marine service was the introduction of an automatic alarm device which can be controlled by a predetermined signal transmitted from any vessel in distress. Apparatus of this nature—see Fig. 2—was designed by the Marconi Company, the Post Office, and the Radio Communication Company, and the Government is about to issue instructions concerning the conditions under which any apparatus of this kind may be installed on board ship as an automatic watch keeper. The Radio Communication

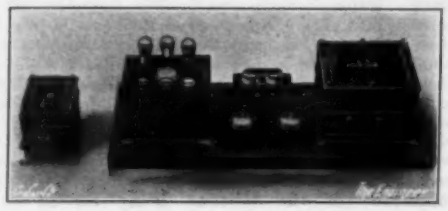


FIG. 2—AUTOMATIC CALL APPARATUS—MARCONI

Company's apparatus—shown in Fig. 3—was described by Major Binyon in his recent address before the Wireless Section of the Institution of Electrical Engineers.

The experimental work on the Marconi rotating beam transmitter at South Foreland was completed during the year, and a demonstration of its capabilities was given in October. During this demonstration tests were carried out on Senatore Marconi's yacht, the Elettra, to determine the range and accuracy of the installation. The extreme range was 100 miles, whilst the reliable working range was found to be about 50 to 60 miles. Particular attention

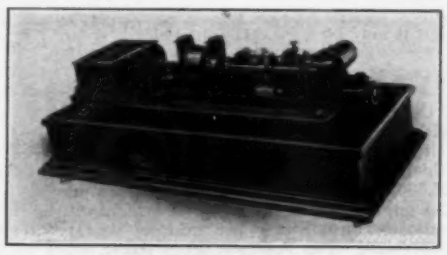


FIG. 3—AUTOMATIC CALL APPARATUS—RADIO COMMUNICATION COMPANY

was paid to the possible bending of the beam by the intervening land, but observations indicated that no such effect occurred.

Marked progress was made in the employment of wireless telephone equipments for communication between lighthouses, lightships and their controlling stations. Automatic beacon stations to be used as wireless fog signals and transmit continuously a predetermined signal during foggy or stormy weather were tried by Trinity House. The first of these stations was installed by the Marconi Company for Trinity House on Round Island in the Scillies for the purpose of experiment, and it will shortly be put into operation. The "public address system," which, of course, is not really a wireless system, was installed by Standard Telephones and Cables, Ltd., in a number of important buildings, including the new Liverpool Cathedral, the Caird Hall, Dundee, and the Hotel Cecil, whilst the Marconiphone Company installed an amplifier system in the House of Lords for the use of the reporters. Tests on the new Rugby wireless station, erected by the Post Office, have been carried out, and the station is now about to be put into operation. A brief description of some of the electrical plant employed in this station was given in our issue of July 24th. An interesting feature of the scheme is the provision of a wireless telephony installation, constructed by Standard Telephones and Cables, Ltd., for communication with America.

Mercury Vapour Rectifiers.

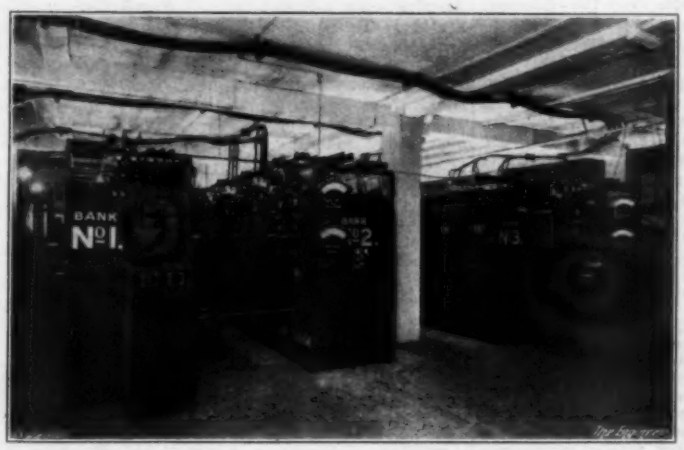
Besides an appreciable increase in the use of mercury vapour rectifiers there was progress in design. The main improvement in the Brown-Boveri rectifier was the elimination of the ignition converter. For the purpose of ignition alternating current is now used. As soon as the main high-tension switch is closed a mechanically interconnected switch completes an auxiliary circuit and the arc is struck. Another improvement is the replacement of the McLeod mercury gauge by a hot wire instrument, which enables the attendant to read the vacuum in the rectifier cylinder from an instrument mounted on the switchboard. Brown, Boveri and Co. report that during the period under review a large number of orders for high-power rectifiers was received, particularly for traction purposes. A repeat order was obtained from the Metropolitan Railway Company of Paris, which in 1923 set a 1100-kilowatt rectifier plant to work in the Nation sub-station, which is on the station platform. The results obtained have led the company to place an order for four of the largest cylinder rectifiers, each having an output of 900 kilowatts at 600 volts. Each cylinder is supplied by a separate transformer and the incoming supply is a three-phase, 10,000-volt, 50-cycle one. Altogether more than sixty equipments were ordered during 1925. The total capacity of this plant was over 60,000 kilowatts. Two of the principal contracts carried out by the Hewittic Electric Company were awarded to the firm by London electricity supply undertakings.

What is believed to be the largest glass bulb mercury vapour rectifier sub-station plant in existence has been put into operation by the City of London Electric Supply Company, and through the courtesy of Mr. Frank Bailey, the Chief Engineer to the company, we were recently permitted to inspect the plant. The rectifiers have been installed as a result of the fact that direct-current is considered to be essential for working lifts and for certain other purposes, but it should be understood that the sub-station is not used entirely for the conversion of alternating current to direct current, a considerable part of the power being sent out as alternating 50-cycle current. From the company's generating station at Bankside three 0·25 three-core cables supply 50-cycle, three-phase, 11,000-volt current to the sub-station situated in the lower part of a large building known as Falcon House, which the company has built in Aldersgate-street, partly for its own office staff and partly for letting purposes. Reyrolle ironclad switchgear deals with the incoming supply, which is fed into transformers made by the British Electric Transformer Company and fitted with Berry regulators. The low-tension sides of these transformers feed on to 2000-volt single-phase switchboards erected by the supply company itself. Distribution is carried out at this pressure to smaller distribution centres by means of 0·5 concentric cables, and at these distribution centres the power is transformed down by 300 kilovolt-ampère transformers to a pressure of 430 volts for distribution on the three-wire system. A supply is also taken from each of the three single-phase switchboards to a Ferguson Pailin cubicle switchboard, which gives a three-phase supply at approximately 4000 volts to four six-phase Hackbridge transformers, each designed for an output of 735 kilowatts. Each of these transformers supplies in turn alternating current to a 500-kilowatt bank of mercury vapour rectifiers made by the Hewittic Electric Company, Limited, and the total continuous-current output is therefore 2000 kilowatts. The direct-current distribution board was manufactured by the City of London Company, and from this board feeders run to various points in order to supply the power consumers who require direct current for lifts and other purposes. Views of the rectifier and static transformer portions of the sub-station are given in Figs. 4 and 5 respectively. The other London mercury vapour rectifier sub-station which the Hewittic Electric Company installed during the year is at Battersea, where a 750-kilowatt installation has been put into operation.

Generating Sets.

The 50,000-kilowatt turbo generating set and condensing plant built at the works of C. A. Parsons for the Crawford-avenue power station of the Commonwealth Edison Company, of Chicago, was officially put into service on May 26th, and since that time the machine has been carrying its full share of the station's load. The reheaters for the plant have not, however, been installed by the supply company, and no steam consumption figures are available. The Barking plant, consisting of two 40,000 and two 20,000-kilowatt Parsons' sets, was put into operation, and a view of one of the 40,000-kilowatt machines is given in our Supplement. In the North Tees power station of the Newcastle-on-Tyne Electric Supply Company C. A. Parsons and Co., Ltd., are erecting two 25,000-kilowatt alternators. The first set is now ready for load and the second machine will be completed shortly. Two Parsons 21,000-kilowatt turbo-alternators are now in the course of erection in the extended Dalmarnock power station of the Glasgow Corporation; a 20,000-kilowatt Parsons set supplied to the Rotterdam municipal power station was put into operation on November 19th; and three 20,000-kilowatt, 50-period sets running at 3000 revolutions per minute were supplied for the Witbank station of the Victoria Falls and Transvaal Power Company. Among the orders received by C. A. Parsons during the year was one for a 15,000-kilowatt turbine for the London Electric Supply Company; a repeat order for a 12,500-kilowatt turbo-alternator designed for a speed of 3000 revolutions per minute for the Mersey Power Company; a 10,000-kilowatt set running at the same speed for the Hackney Borough Council; a 6000-kilowatt turbine and gearing for coupling to direct-current generators for the Castner Kellner Alkali Company; and a 15,000-kilowatt set for the city of Leeds. Orders for other large machines were received from the Derby Corporation, Perth, Western Australia, and the United States, &c. The aggregate output of the Parsons' turbines manufactured was about 328,000 horse-power, of which 15,000 horse-power was applied to the driving of mechanical gears for mills and low-speed electrical generators. The aggregate capacity of the alternators dispatched was 410,000 kilovolt-ampères.

Besides orders for high-pressure and mixed-pressure turbo-alternator sets, the British Thomson-Houston Company manufactured direct-current and alternating-current geared sets and turbine geared sets for mechanical drives, several of these turbines being extraction machines designed for supplying back-pressure steam at one or more pressures for process work. Turbine and motor-driven centrifugal blowers for scavenging and for super-charging marine Diesel engines were manufactured. Among other important orders which the British Thomson-Houston Company secured was one for a 20,000-kilowatt set for the Nottingham super-power station. A repeat order was received from the City of London Electric Lighting Company for a 10,000-kilowatt set and two 15,000-kilowatt sets. From the Winchester Corporation the company secured an order for a steam turbine running at 6000 revolutions per minute and geared to a 1250-kilowatt generator running at 750 revolutions per minute. The General Electric Company is completing one of the largest British electrical plants, namely, the plant at the Nechells power station of the Birmingham Corporation. A repeat order was received for two additional 22,500-kilovolt-ampère G.E.C.-Fraser and Chalmers turbo-alternators, and when the work is completed this station will contain five 22,500-kilovolt-ampère sets of the General Electric Company's make.



FIGS. 4 AND 5—MERCURY VAPOUR AND STATIC TRANSFORMER SECTIONS OF SUB-STATION

The company has in hand a 15,000 kilovolt-ampère turbo-alternator for the Adelaide Electric Supply Company, a similar machine having been supplied last year. General Electric turbo-alternators have now been delivered to the main power stations at Adelaide, Sydney and Brisbane. At the present time machines are in course of construction for the Battersea Borough Council, and for the Portsmouth, Southampton and Sunderland corporations. For the Woolwich Borough Council the company is building two turbo-alternators, one of 15,000 kilovolt-ampères capacity and the other of 7500 kilovolt-ampères capacity. The Darlington, Glasgow, and Harrogate corporations have also placed orders with the General Electric Company for turbo-alternators, and many orders have been received for alternators and direct-current dynamos for private electricity supplies.

Important contracts for turbo-generating sets were placed with the Metropolitan-Vickers Electrical Company. One of the contracts is for a 40,000-kilowatt machine and two sets of 35,000 kilowatts and one of 30,000 kilowatts, all complete with alternators and control flow condensers and auxiliary plant. All the turbines are two-cylinder machines, with the company's multi-exhaust blading in the low-pressure cylinder. Each of the alternators is rated at 40,000 kilovolt-ampères. Practically all the alternators supplied during the past twelve months were arranged to work with the company's closed-circuit ventilating system. Another interesting machine which is being supplied by this firm is a 12,500-kilowatt turbo-generator, designed for a speed of 3600 revolutions per minute. Notwithstanding this high speed, the materials employed are not stressed beyond the limits commonly adopted in machines running at lower speeds. By reason of the high speeds adopted, the cost of the machine and the space which it occupies have been materially reduced. The demand for turbines combined with double-reduction gearing, for the direct driving of paper mills and textile works, was found by the Metropolitan-Vickers Electrical Company to be considerable, and in some instances auxiliary generators were coupled to the turbine to supply electrical energy for driving outlying plant. Some of these turbines, moreover, have been arranged to pass-out steam for heating and process work.

The English Electric Company claims to have taken the lead in the production of large units, running at a speed of 3000 revolutions per minute. The 20,000-kilowatt machine which the company recently set to work at Bradford, and which is illustrated in one of our Supplements to-day, is believed to be the largest single line turbine built for that speed so far constructed. A brief description of the machine will be found in our issue of November 20th.

A gear-driven alternator was built by Mather and Platt, Ltd., for use in a paper mill. The machine is rated at 2500 kilovolt-ampères, and is driven by a turbine through the gearing at a speed of 500 revolutions per minute. On the alternator shaft there is, in addition to the exciter, a direct-current generator which meets the direct-current requirements of the mill. Several firms built some rather unorthodox generators which are worthy of mention. Mr. Hunt's self-synchronising alternator—described in our issue of May 8th—for example, is a machine well suited for coupling to gas engines, and it is claimed to be capable of running in parallel with other alternators under very adverse conditions. Another machine which is quite unique is a 6000-kilowatt direct-current generator capable of giving 25,000 ampères at a pressure of 240 volts. It was built by Mather and Platt, Ltd., and it is believed to be the largest generator of its kind. The same firm constructed a 3000-kilowatt geared generator, which is driven by a compound turbine at a speed of 500 revolutions per minute.

A view of the generator house of the re-constructed Bow Generating Station—described in our issue of May 15th—is given in our Supplement.

Sub-station Plant.

There was no falling off during the year in the demand for converting machinery. In the past all British electrical manufacturers, with the exception of Bruce Peebles and Co., Ltd., confined themselves to the manufacture of two types of converters, motor generators and rotary converters, but several firms, in addition to Bruce Peebles and Co., are now building motor converters. The British Thomson-Houston Company has increased the speeds of these machines to a comparatively high value, so as to produce converters which occupy a small amount of floor space for a given output. Within recent times some large rotary converters have been built. Orders were received for three 1500-kilowatt B.T.H. machines and a 2000-kilowatt machine from the London Electric Railway. Repeat orders were obtained from the London County Council for B.T.H. rotaries, and the year's orders bring up the total capacity of converter plant supplied by this firm to these two customers to 33,500 and 14,000 kilowatts respectively, whilst the orders for B.T.H. motor converters from various sources represent 27,000 kilowatts. Large contracts for rotary converters were received by the General Electric Company from the Southern Railway, from Birmingham, Portsmouth, Keighley, West Bromwich and the Southampton Corporations, the county borough of South Shields, and the municipality of Singapore. The company manufactured several motor converters, and machines are now going through the shops for the Battersea Borough Council, the Aberdare Urban District Council, and the Plymouth Corporation. A machine of this type is in the course of erection in the power station of the Willesden Urban District Council. Among the manually controlled rotary converters supplied by the Metropolitan-Vickers Electrical Company were three 3000-kilowatt machines for Buenos Aires, a 2000-kilowatt machine for Bombay, and an additional 2000-kilowatt converter for the Melbourne City Council. Crompton and Co., Ltd., report a large demand for converters, and two Crompton 1500-kilowatt auto-synchronous motor generator sets were installed in a sub-station at Brighton. The English Electric Company also found that the demand for converting machinery was well maintained. Seven of the sub-stations on the Southern Railway were equipped by this firm. The contract involved the manufacture of nineteen 1500-kilowatt converter equipments, complete with transformers and high and low-tension switchgear. These converters were, of course, designed for 650 volts, but other machines working at pressures of 1500, 2400 and 3000 volts, have recently been built for abroad. The limiting voltage for a single-armature rotary converter is at present 1500 volts, and it is the usual practice when higher pressures are required to employ motor generators with the direct-current machines connected in series.

Bruce Peebles and Co., Ltd.—the first firm in the United Kingdom to manufacture motor converters—continues to find a ready sale for this class of machine. Among other converters supplied during the period under review were two 2000-kilowatt motor converters for the Imperial Government Railway, Japan, and six 1000-kilowatt motor converters for India. The Mather and Platt self-synchronising rotary converter, to which we alluded last year, met with increased favour during the past twelve months, the Kingston-upon-Hull and Manchester Corporations having purchased them.

Automatic Sub-stations.

Having apparently justified their existence, automatic sub-stations are making appreciable headway in this country and elsewhere. For the past year the Metropolitan-Vickers Electrical Company's contracts of this nature are noteworthy. Over twenty-six automatic rotary converter equipment contracts were dealt with, as well as orders for automatic re-closing feeders. The principal installations are three 1500-kilowatt sets for the City and South London Electric Railways, two 750-kilowatt sets for the Manchester Corporation, two additional 500-kilowatt sets for the Birmingham Corporation, and two installations with eight traction equipments for the Bradford Corporation. A fourth equipment for Dublin is nearly complete, and an installation worthy of note is one for the Charing Cross Railway for underground operation at Soho-square.

An interesting development was the introduction by the Metropolitan-Vickers Electrical Company of electrical supervisory control, which adds to the benefits of automatic control the advantage of remote control and the possibility of obtaining at the point of control information regarding the conditions and operations at the sub-station. A demonstration of this new system of supervisory control with a 750-kilowatt rotary converter manufactured for the City of Wellington, New Zealand, was given at the Metropolitan-Vickers Electrical Company's works on October 9th. A view of the equipment will be found in our Supplement. Similar equipments, including sixteen 1250-kilowatt rotary converters for the Bombay, Baroda and Central India Railway are approaching completion. Nearly 100,000 kilowatts of automatic or unattended sub-station plant was supplied by the British Thomson-Houston Company. A large order for automatic control gear for rotary converters on the South African Railways was received by the General Electric Company.

THE bulk of the electrical machinery imported into China is for lighting purposes, and as evidence of the extent to which the use of electricity in China has developed, in spite of the unfavourable conditions existing during recent years, it may be mentioned that a list of electric light plants in that country, published last year by the Chinese Government Bureau of Economic Information, contains the names of more than 220 such undertakings, without taking into account many private installations. Details of the capacity of these plants are lacking in many cases, but it has been estimated that the total exceeds 400,000 kilowatts. In 1924 the imports into China under the heading of "electrical materials and fittings" were valued at Hk. Tls. 8,194,962. From the point of view of British manufacturers, the year was particularly difficult, owing to the practical impossibility of meeting continental competition, German, Swiss, Swedish and Danish electrical equipment being sold there at prices which British firms could not possibly meet. Mr. H. J. Brett, the Commercial Secretary at Shanghai, in his annual report, says he has been informed by the representative of one important British manufacturer that in the case, for example, of 40-kilowatt installations, for which a fair demand exists, the difference between British and continental prices amounted in some instances to as much as 90 per cent., and although the British machinery was admittedly better, the discrepancy in price was too great to be bridged.

Sanitary Engineering in 1925.

General Outlook.

IT is satisfactory to be able to report that there is a very large amount of work now in hand throughout the country. Although pre-war activity has not been regained, yet there are evidences that extensions and new works which, though they were badly enough needed ten years and more ago, were postponed owing to the war, are now being seriously taken in hand. Many of them are, in fact, actually being carried out. Three other factors are contributing to this revival of activity; the first is that various municipalities are increasing or have recently widened their boundaries, which entails the rearrangement of their sewage disposal undertakings,; the second is that there has been a large increase in the building of houses; while the third is the desire to give work to the unemployed and the facilities which now exist for obtaining grants in aid. The magnitude of the schemes being carried out varies considerably in different places—from a few thousand to several hundreds of thousands of pounds—and the nature of the work being done also shows considerable diversity. An encouraging aspect of the situation is that the movement is widespread, and is not confined to any particular locality. Unfortunately, it cannot, however, yet be reported that the engineers with expert knowledge of these matters are by any means fully employed. While it cannot be said that any particular novelty has been introduced in methods of treating sewage, development has proceeded in several directions, notably in the several modifications of the activated sludge system. A really ideal means of treating and disposing of the sludge has still to be discovered. That subject offers a fine field for research, and a very substantial fortune for him who is skilful and fortunate enough to solve the problem satisfactorily so that it may be universally applicable.

London Main Drainage.

Considerable progress was made during the year with the comprehensive scheme of new works for the relief of flooding in the Metropolis, the total cost of which, estimated on a pre-war basis, was about £2,500,000. The Hammersmith pumping station, the gross pumping capacity of which will be 1000 tons of storm water per minute, was practically completed. The South-Western storm relief sewer, which is intended to receive storm water overflowing from important sewers in the neighbourhood of Brixton, and to discharge it into the river Thames at Nine Elms, was also practically completed. This sewer is about 2¾ miles long, and the greater part of it is an iron-lined tunnel, 11ft. 4in. in diameter. The Streatham Hill sewer, a brick sewer 4ft. internal diameter, which is designed for the relief of floodings in certain parts of Streatham and Brixton, was finished. It is nearly 1¼ mile long.

Another sewer, which is well advanced towards completion, is known as the Lewisham Branch Sewer, and is intended for the relief of floodings in Lewisham and district. It runs from Bell Green, Lower Sydenham, to a junction with the Southern High Level Sewer No. 2, near Court Hill-road, Sydenham. Another sewer will also be constructed from Catford Station. The total length of these sewers will be approximately 3 miles. They are being constructed principally in tunnel, in brickwork, and their internal diameters vary from 5ft. to 9ft. The greater part of the Eltham sewer, designed to relieve floodings in Eltham, Kidbrooke, Greenwich and Woolwich, is also nearly finished. It is about 2¼ miles long, and is 8ft. in internal diameter. It runs from Eltham-road, near Eltham Green, to the Southern High Level Sewer No. 2 at Charlton, and is constructed partly in brick, and partly in iron, principally in tunnel.

Good progress was also made with another important work, known as the North-Western Storm Relief Sewer, which is to obviate floodings such as have occurred from time to time in parts of Willesden, Kilburn and Hampstead. It consists of about 5½ miles of sewer—including branches—and it varies from 4ft. 6in. to 9ft. 6in. in diameter. Its outlet into the river Thames adjoins Hammersmith Bridge. All of it is in tunnel, and the lower portion is shield-driven and lined with cast iron. Considerable portions of it had to be carried out under compressed air.

The construction of the Beverley Brook Relief Culvert, which is to be 750 yards long and 8ft. in diameter, is well in hand. It runs from Priests Bridge, Upper Richmond-road, direct to the river Thames. This culvert will enable the flood waters of the Beverley Brook to discharge into the river at all states of the tide, instead of being ponded up at high water.

Manchester.

During the year Manchester applied for and obtained sanction to expend over £450,000 in extensions to the Davyhulme sewage disposal works. The works, which have not yet been begun, will include an extensive air diffusion treatment plant, which will itself cost nearly £277,500, a "bio-aeration" unit and a "Simplex" unit. It is interesting to

note therefore that Manchester, the home of the original air diffusion method of activated sludge treatment, while still, evidently, placing most reliance on that method, is wide-minded enough to give a trial to two of the later developments of the process. Moreover, it is proposing to do so on a practical—not laboratory—scale, for each of the new units is to be capable of treating 1,000,000 gallons of dry-weather flow sewage in twenty-four hours.

Work in connection with the city's main drainage scheme was in full progress throughout the year. Work No. 4, which comprises a barrel sewer in brickwork, 12ft. internal diameter and nearly 2 miles in length, running from Upper Moss-lane to Great Ancoats-street, was completed. Work No. 5 comprises the length of sewer from the junction with work No. 4 in Great Ancoats-street to Market-street, Blackley, a distance of 4 miles, and the diameters range from 12ft. to 4¾ft. The first length of this work, from Great Ancoats-street to Angel-street, about 1 mile in length, was completed and put into operation, together with work No. 4, into which it discharges. The flow in the existing and overcharged sewers was turned into the new sewer on October 31st. The remaining portion of work No. 5 is now well in hand. It has been found necessary, on account of the bad nature of the ground, to construct a considerable length of sewer at the northern end of the work in cast iron with brick and concrete lining. That part of the work is being carried out under compressed air, at a pressure varying from 10 lb. to 23 lb. The depths of the sewer from the ground surface vary from 70ft. to 141½ft. The construction of the Gorton relief sewer was commenced on November 2nd. This sewer, which is intended for the relief of the overcharged sewers in the Gorton district, will vary in size from 12in. diameter pipe sewer to a 3ft. 9in. diameter brick sewer. It will have a total length of about 1¼ mile and a depth to invert varying from 34ft. to 12ft.

Leeds Main Drainage and Sewage Disposal Works.

A further length of 2 miles of new high level intercepting sewers was driven at a cost of about £90,000, making the total length of sewers completed 6 miles. The total amount expended on sewers to date has been £280,000, and the additional length of sewer remaining to be constructed, which will, it is estimated, cost about £50,000, is due for completion in about eighteen months' time.

At the disposal works at Thorpe Stapleton, which, as our readers are aware, have now been under construction for a number of years, 9 acres of new percolating filter beds were completed during the year, making 30 acres in all put to work. The construction of six additional acres of similar filters has been in progress, and when they are completed, probably within the next six months, the filter requirements for some time to come will have been met.

The difficulties which were experienced during 1924 in preparing the foundations for the new low-level precipitation tanks, in consequence of the presence of silt, were overcome during last year, and the sinking of the concrete cylinders to form the foundations was completed. A commencement was also made with the actual construction of the tanks and channels, which are to form the superstructure. Good progress was also made with the construction of the tanks for the treatment of storm water, which are due for completion in six months' time. When they are at work the sewage tank equipment on the high-level works will meet all present-day requirements.

The gross capital expenditure during the year amounted to about £296,000, and the total expenditure on the whole scheme to date amounts to some £1,694,000.

Bradford Esholt Scheme

During the year Bradford suffered a severe loss by the death of Mr. Joseph Garfield, M. Inst. C.E., its Sewage Works Engineer, who was responsible for the extensive Esholt disposal scheme, which has been in progress for a number of years now. Mr. H. Wontner-Smith, M. Inst. C.E., who had acted as deputy for Mr. Garfield for several years, has been appointed to succeed him. From him we understand that good progress was made during the year with the construction of the Esholt works, and that the time is now approaching when the first section of them will be put into operation. Work on the tunnel, which is to convey the sewage to the disposal site, and on making the connections thereto, is so far advanced that, in the early spring, the tunnel will be brought into full use, and then the old works at Frizinghall will be entirely abandoned. The detritus tanks, the syphon across the Aire Valley, one-half of the precipitation tanks, and one-third of the area of filters will be put into operation. Six of the seven storm water tanks have been finished.

The Wandle Valley Joint Sewerage Board.

On October 30th the remodelled disposal works near Wimbledon of the Wandle Valley Joint Sewerage Board were formally opened by Sir Arthur Spurgeon, chairman of the Public Health Committee of the Surrey County Council. These works, which we hope shortly to describe in detail, are of considerable interest from several points of view. For instance, the remodelling had to be carried on without interference with the working of the pre-existing installation, and the plant is self-controlled, electrically driven pumps being cut in and out automatically in accordance with variations in the flow of the sewage. Furthermore, the site on which the works have been constructed consisted of swampy land alongside the river Wandle and below flood level. The works are designed to deal with the sewage from a population of 96,000 people, and they comprise sedimentation tanks, rectangular bacteria beds with power-driven distributors, humus and storm water tanks, sludge presses, &c.

New Main Drainage Works at Falmouth.

The first portion of the new Falmouth main drainage works was opened by the Mayor on November 30th last. The scheme has been designed to provide for an ultimate population of 20,000 persons at 25 gallons per head per day. In the past the sewage flowed into the harbour at various points in a crude state, and the new scheme is designed to intercept all the existing outfalls and discharge the sewage into the mouth of the harbour at such periods of the tide as will ensure it being swept out to sea and not returned on to the foreshore. From float experiments it was ascertained that the best position for a discharge would be at low water mark at Middle Point, and that it would be safe to discharge crude sewage from half flood tide to high water and thence on to half ebb. The fact that the proper period for the discharge of the sewage is from half flood through high water to half ebb necessitates the whole of the sewage of the town being delivered to the outfall at such a height that it can be discharged at the level of high water on ordinary spring tides. Under the circumstances it is not possible to gravitate the whole of the sewage to the outfall, and the sewage from the low-lying portions of the town has to be pumped. It is also necessary to provide a storage tank, so as to hold up the sewage during unsuitable hours. The storage tank provided is designed to hold 400,000 gallons, which is sufficient to store three times the dry-weather flow during the prescribed period.

The end of the tank is provided with a weir at about the level of high water spring tides, and if the flow exceeds the rate of three times dry-weather flow and the tank becomes full, discharges will be allowed to take place of sedimented sewage at any state of the tide. Considerable difficulty was experienced in finding a suitable route for the main outfall sewer, as the streets are exceedingly narrow and already full up with existing sewers, water mains, cables, &c. The route chosen involves a considerable length of tunnel, mostly in rock. In order to avoid the expense of constructing a large number of deep manholes, the headings have been left open, so that the sewer can be inspected. The main outfall sewer commences with a diameter of 12in., and the final length is of 21in. diameter. The low-level sewage will be raised from two ejector stations operated by means of an Adams "Auto-ram" sewage lift, the high-level sewage in the existing sewers being utilised for compressing the air.

Salford.

On October 22nd, the remodelled and enlarged disposal works at Weaste, of the Salford Corporation, were formally put into service, though the work is not yet quite completed. The total estimated cost of the alterations and extensions included in this scheme was £448,084, and work has proceeded sufficiently far to make it certain, so we understand, that that figure will not be exceeded. The sewage enters the works at two levels. The low-level detritus tank is 110ft. long, 25ft. wide and 44ft. deep, and it is fitted with an electrically driven travelling dredger, which is capable of lifting 200 tons of detritus through a height of 64ft. in a working day, and is one of the largest of its kind. The low-level pump house contains four electrically driven pumps, each with a capacity of 12,000,000 gallons per day, one pump capable of lifting 20,000,000 gallons per day, a 6in. vertical spindle pump and a drainage pump. The high-level detritus tank is 34ft. long, 23ft. wide and 21ft. deep. The original percolating filters, which cover an area of 40,000 square yards, have been deepened from 6ft. to 9ft. so as to increase the total content of filtering material to not less than 110,000 cubic yards. A new rectangular percolating filter, 7ft. 6in. deep, and capable of containing 8700 cubic yards of filtering material, is under construction. The three humus tanks are each 216ft. long, 22ft. wide and 31ft. deep, and their aggregate capacity is 1,000,000 gallons. The sludge is taken to sea by steamer, being first delivered into two circular collecting tanks, which, when full, can contain nearly 3000 tons of sludge and detritus. There are four storm-water tanks, 15ft. deep, with an aggregate capacity of 1¾ million gallons. Considerable difficulties were met with during the construction of the various tanks, owing to the bad nature of the ground in which they had to be built, and to water, but they were successfully overcome.

Works Completed, Under Construction, or in Contemplation.

The Romford Rural District Council extended the intercepting sewers in connection with its riverside scheme, which was put to work in 1924, including the sewer running to the outfall works from the eastward, a distance of about 2 miles through the parishes of Rainham and Wennington. That sewer had to be laid in very difficult ground and special means for supporting the pipes were required. At one point it passes under Rainham Creek, 11ft. below the bed of the stream, with a head of water up to 16ft. at high water. The crossing was carried out in a tunnelled heading, 5ft. by 4ft. 6in., and was 300ft. long from bank to bank. Doncaster completed the first portion of a new sewage disposal scheme, which will eventually cost some £350,000. Camborne is carrying out new works at a cost approximately of £50,000. Redruth and Illogan have in hand a joint scheme to cost £100,000. Farnborough, Hants, is considering various proposals for new sewage disposal works, including one in which it is suggested that it should join with Aldershot and other districts. Leatherhead is proceeding with the reconstruction of its disposal works, which also take the sewage of Ashtead parish. The new works will have a capacity equal to 600,000 gallons per day dry-weather flow. Bexhill is constructing a new relief sewer and outfall to cost £84,000. Brighton and Hove have in hand an extensive new joint outfall scheme. Hull is spending £78,000 on a conversion to water-carriage scheme. The Matlock sewerage works, which have cost over £80,000, were completed. Rochester and Chatham have in hand an extensive joint scheme, the cost of which is given as being in the neighbourhood of £400,000. Richmond is reorganising its sludge-pressing plant, ten presses are to take the place of three, and electrically driven air compressors will be substituted for steam-driven machines. Wolverhampton has in hand new disposal works at Barnhurst to cost £50,000. The Birmingham, Tame and Rea Drainage Board is proposing to construct a new outfall sewer and to spend £40,000 on bio-aeration treatment works. Sheerness has in hand a scheme involving an expenditure of £34,000. Nottingham is considering an extensive reconstruction scheme. Prestonlee reopened its remodelled and extended works in March, and Colwyn Bay and the Colwyn Urban District Council opened the New Mochdre disposal works in the same month. A Ministry of Health inquiry was held as to the new proposals of Banstead, which are to cost approximately £100,000. Worksop opened the first portion of its new works in June. The inquiry was held regarding a complete re-drainage scheme for Lytham and St. Annes, which includes the laying of a 54in. cast iron outfall, and which will involve an expenditure of some £500,000. Uxbridge has in view a sewerage scheme to cost over £80,000. The Chesterfield Rural District Council has adopted a joint sewerage scheme to cost some £90,000. Knutsford is to construct new disposal works at an outlay of over £61,000. Wirrall is considering the expenditure of £130,000 on a sewerage scheme for the Moreton district. Stoke-on-Trent is carrying out new works to cost £120,000. Jarrow decided to proceed with a water-carriage scheme to cost £57,000. Winchester is laying down additional pumping machinery and constructing further sedimentation tanks on its existing sewage farm. Leamington is engaged in nearly similar works. Spalding has a new scheme under consideration which is to cost some £70,000. Dewsbury applied for sanction to borrow over £40,000 for new tanks, filters, sludge presses, &c. Ammanford received sanction to borrow over £47,000 for its new sewerage scheme. Bolton approved of a new activated sludge treatment scheme to cost £63,000. In addition to the foregoing works of greater or less importance are being carried out or contemplated by the Thorne Rural District Council, Rhosneigr, Felixstowe, Harrow, Sedgley, the Godstone Rural District Council, Battersea, the Cwmmannan Urban District Council, Paisley, Nelson, Epsom, Cramlington, Cannock Rural District Council, Portsmouth, Bedlington, Coseley, Southend, Ashford, Leicester and many others.

New Disposal Works at Reading.

The new sewage disposal works at Reading were completed during the year, and are noteworthy in that they have been designed to treat the whole of the sewage from a population of some 90,000 persons—a daily dry-weather flow of 3,000,000—by the activated sludge process. The sewage enters the works through a 36in. diameter pipe, and after being screened passes to either one of three detritus tanks, each of 14,000 gallons capacity. From there it passes to a chamber where a certain quantity of activated sludge is added to it, after which it is raised by air-lift pumps to the aerating tanks, of which there are four, each having a capacity of 436,000 gallons. For furnishing the pressure air there are four compressors, each driven by a 50 brake horse-power electric motor, and each designed to pass 650 cubic feet of free air per minute at a pressure of 15 lb. per square inch, as an ordinary working load. For use in case it may be necessary to by-pass any of these tanks, there are three connecting tanks, each of 63,000 gallons capacity. After the requisite aeration, the treated liquid passes to one of two settlement tanks, each holding 225,000 gallons. Two tanks, each of 131,000 gallons capacity, are provided for re-aerating the return sludge. For drying the sludge there are nineteen clinker beds, each having an area of rather over 1000 square yards. The works, though

they have been completed for some time, have not yet been put into full operation, owing, we understand, to certain mechanical and chemical difficulties which have been encountered, and to overcome which measures are now being taken.

Apparatus for Measuring Cutting Temperatures.

IN the December issue of the *Journal* of the Institution of Mechanical Engineers, a very interesting paper on "The Measurement of Cutting Temperatures," by Mr. E. G. Herbert, M. Inst. Mech. E., of Manchester, is published. In this contribution the author gives the results of a number of experiments of an original character which he has carried out to ascertain and record the temperatures produced in tools performing different kinds of work. As the author points out, a knowledge of the actual temperatures is of twofold importance. The temperature may, if high enough, affect the hardness of the tool, and for that reason it is important to know both the temperature involved and the heat-resisting properties of the tool—its hot hardness. The temperature produced by working may also affect the various physical properties which constitute machinability in the work material.

As it is not possible to introduce a pyrometer at the actual point where heat is generated in cutting, Mr. Herbert has devised the ingenious plan of using the tool itself and the work material as the two elements of a thermo-couple, and measures the temperature at their surface of contact by the electromotive force generated in the "tool-work thermo-couple." The procedure consists in insulating the tool from the slide rest or tool-box of the machine by means of strips of mica. One terminal of a unipivot millivolt meter is then connected to the insulated tool and the other terminal to any convenient part of the machine. The method of measurement is easily applicable to cutting operations in which the temperature is reasonably constant, or subject only to such slow variations as may be caused by the gradual heating up of the tool and the work as the cutting proceeds. But there are many operations in engineers' workshops in which the temperature of the tool is subject to periodic variations, while in certain classes of operations, such as punching and shearing, press work and processes in which blows are employed, the rise and fall of temperature may occupy only a fraction of a second. In such cases the voltage generated by the thermo-couple cannot be measured by means of an ordinary voltmeter owing to the inertia of the moving coil and needle. To overcome this difficulty Mr. Herbert has devised the apparatus, of which an illustration is given in Fig. 1. In this apparatus Professor Einthoven's string galvanometer, with the thin fibre of glass, plays a conspicuous part. The fibre is coated with gold to render it a conductor, and is stretched in the field of a powerful electro-magnet. By suitable optical arrangements the vertical shadow of the fibre, magnified 600 times, is projected on a screen bearing a graduated horizontal scale. The following is a description of the complete apparatus, which we have had the pleasure of inspecting at the works of Edward G. Herbert, Ltd., Levenshulme, Manchester:—The source of light is an arc lamp A, the beam from which passes through the water bath B to the string galvanometer C, consisting of a powerful electro-magnet with a hole bored through both pole pieces to allow the beam of light to pass. The glass fibre ·007 mm. in diameter is contained in the brass fibre case D, inserted between the magnet pole pieces. The fibre is stretched across a small mica window in this case, and is magnified by a microscope objective mounted inside one of the magnet pole pieces. The tension of the fibre is regulated by a screw E, and its position in the field by a screw F. The metallurgical microscope G does not perform any function in the recording of temperatures except to support the projection lens H. The beam of light, after emerging from this lens, passes through the plano-cylindrical lens K, that concentrates it into a horizontal beam, which traversing the bellows, falls on the graduated screen L on the falling plate camera O. The dark slide containing the photographic plate is suspended inside the camera from the hook M attached to the piston-rod of the oil dashpot N. The magnified image of the fibre is focussed and adjusted on the sliding screen L, which can be drawn back to expose a semi-cylindrical lens about 4in. long on the back of which are millimetre graduation lines. Behind this lens and immediately in front of the photographic plate is a narrow slit which is brightly illuminated except where the shadow of the fibre falls across it. An extension to the arm of the metronome J passes across and obscures the beam of light at intervals of one second, thus causing unexposed time lines to appear in the photograph.

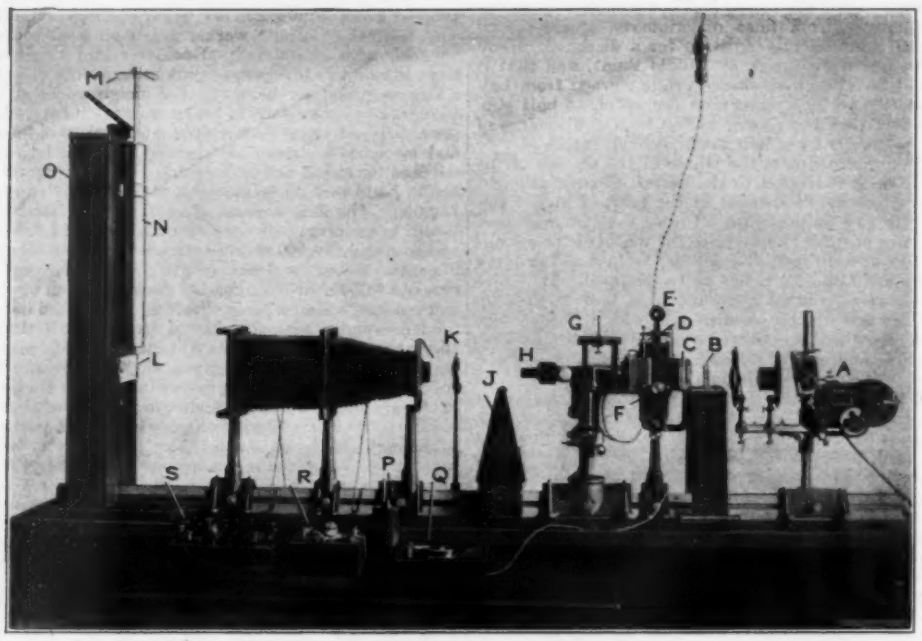


FIG. 1—ARRANGEMENT OF APPARATUS FOR MEASURING AND RECORDING CUTTING TEMPERATURES

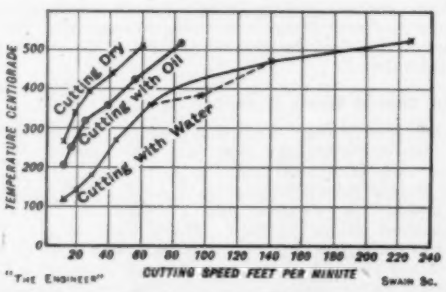


FIG. 2—TEMPERATURE CURVES OBTAINED WITH LATHE

A standard voltage of 2 millivolts is obtained from the dry cell P, in conjunction with the resistance S, rheostat R and millivolt meter Q. This standard voltage is applied to the fibre, the tension of which is so adjusted that its image deflects one centimetre or two centimetres per millivolt, according to the character of the record to be made. The fibre having been calibrated, it is connected to the tool work thermo-couple, the slit is exposed by drawing back the sliding screen, and the plate is released. The millimetre lines on the semi-cylindrical lens trace graduation lines on the falling plate, the metronome produces time lines, and the shadow of the fibre traces an unexposed line. Every movement of the fibre is recorded as an undulation in this line, the amplitude of the undulations serving to measure the voltage and the temperature at the point of contact between the tool and the work.

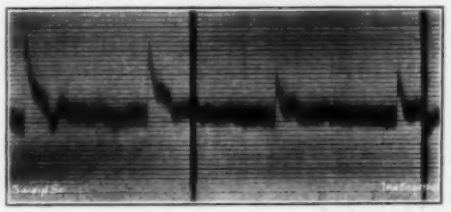


FIG. 3—THERMOGRAPH, CHIPPING MILD STEEL BAR

Mr. Herbert has carried out tests of various kinds, with stellite cutting tools operating on steel bars, with stellite chisels chipping mild steel and for cutting files, scraping a steel surface, shaping, sawing and tapping, and thermographs obtained from these operations are published in the paper to which reference has been made. The results are instructive; for instance, it appears that a temperature of 120 deg. Cent. was generated by hand tapping a ¼in. hole in bronze, while the maximum temperature obtained in sawing a mild steel bar was probably over 1000 deg. Cent.

Fig. 2 shows the temperature generated by a No. 2 stellite tool turning a mild steel bar 2½in. diameter on a bar lathe. The tensile strength of the mild steel was 29·7 tons per square inch. The depth of cut was in all cases ⅛in. The stellite knife tool had top rake 27 deg., clearance 6 deg. Tests were made dry, with machine oil, and with water containing a soluble cutting compound. The tests were made with a fixed feed of 43 revolutions per inch traverse, and at various speeds.

Fig. 3 is the thermograph produced by chipping a mild steel bar with a No. 2 stellite chisel. In this operation the temperature generated rose in one one-sixtieth second to a maximum of 160 deg. Cent., and fell in one-ninth second to normal. Fig. 4 gives the thermal history of

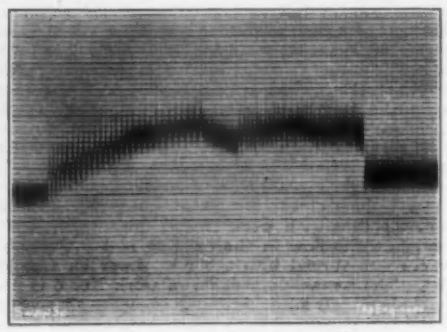


FIG. 4—THERMOGRAPH, TAPPING ¼IN. HOLE

tapping a ¼in. hole in alumimium bronze by hand. Starting from the left the temperature rises due to every movement of the tap can be clearly seen; the temperature falling after each movement, but showing a general rise as the tool and the work become warmer. At *a* the tapping process was completed, and a pause of 7½ seconds was made, during which the temperature fell somewhat. The tap was then backed out and finally removed from the hole, where the sudden drop in voltage is seen. The tap bronze couple was calibrated and the maximum temperature found to be 120 deg. Cent. Fig. 5 is a thermograph which was made in the presence of our representative, and shows the effect of knocking an American nail into a block of timber. The

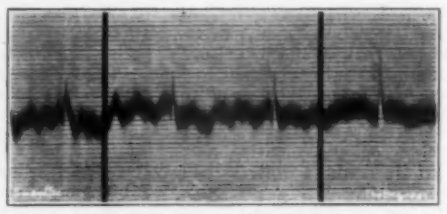


FIG. 5—THERMOGRAPH. KNOCKING IN NAIL

temperature generated by each blow is clearly seen, but owing to vibration of the apparatus, the zero line is seen to be very uneven.

This paper is to be discussed at the Institution, Storey's Gate, Westminster, on February 19th.

INSTITUTION OF CIVIL ENGINEERS.

ASSOCIATION OF LONDON STUDENTS.

AT a meeting held on Wednesday, December 16th, the Vernon-Harcourt Lecture was delivered by Sir Cyril Kirkpatrick, M. Inst. C.E., member of Council. Mr. Frederick Palmer, C.I.E., Vice-president of the Institution was in the chair. The subject of the address was "The Development of Harbour and Dock Engineering."

In giving the history of harbour development, the lecturer commenced with the pre-Hellenic harbour at Alexandria, 2000 years B.C., the first in Egypt, which was rebuilt by Alexander the Great in 332 B.C. The fall of the Roman Empire marked a decline in the art of engineering The first permanent dry dock to be built was at Portsmouth. It was completed in forty-eight weeks at a cost of £198, and was enlarged by Henry VIII. In 1661 Pepys mentioned the building of the first wet dock at Rotherhithe. It had a length of 1070ft. and a breadth of 450ft. It was not for the discharge of cargo, but was a refuge for ships to enter in rough weather, the trees surrounding it acting as a screen. The third wet dock to be constructed in England was at Bristol in 1712. Southampton, with its floating dock, the largest in the world, was mentioned. There the second high tide, occurring two hours after the first, facilitates the handling of large vessels.

After describing Amsterdam, the author said that in 1690 the entrance to the Zuyder Zee had silted up to such an extent that vessels were lifted on pontoons and carried across the shoals, the first use of a type of floating dock. In America developments had been mainly in the direction of jetties at right angles to the shore. The two types of quay in general use were reinforced concrete and timber. The future of the latter depended upon the success attending the efforts to combat the teredo navalis.

In concluding, the author indicated how development in the future would have for its object the reduction of the cost of transport.

FROM next summer the eleven o'clock West of England express from Waterloo will be known as the "Atlantic Coast Express." The Southern Railway recently invited suggestions from the staff for the best name, and the general manager, Sir Herbert Walker, selected the "Atlantic Coast Express" as the winning title. It was sent in by four competitors, and a prize of three guineas has been awarded to Guard F. Rowland, of Waterloo, whose entry bore the earliest date of the four, consolation prizes being given to the three others.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Extended Holidays.

THE Christmas holiday was prolonged in the Midlands and Staffordshire. A number of the works re-started in the middle of the week, but the majority were idle during the whole of the week, having a very slender carry-over of orders, which, unfortunately, have not been appreciably added to in the interim. The attendance at the weekly meeting of the Midland iron trade in Birmingham on Thursday was not up to average, and very little business was done. With most of those present, the day was largely one of inquiry as to possible business in the New Year. Such business as was put through followed the market tendencies which had previously developed. Some of the steel makers stood out for better terms with regard to structural material. Unanimity being lacking, however, the movement gathered little weight. Members on 'Change expressed a certain amount of confidence in the New Year prospects. There is good reason, they hold, for believing that 1926 will pull industry further out of the rut of post-war depression. Recovery may continue to be slow, but it should be sure. Some big contracts, calling for large quantities of iron and steel, and providing work for engineering firms, are likely to come into the market quite early. The cheerful tone which characterised conversations on 'Change is all to the good, and given peace in the labour world the hopes now expressed should materialise, if not to the extent some optimists look for, at least to the extent of fulfilling the anticipations of less buoyant members of the iron and steel and engineering industries in this district.

Iron and Steel.

There has been little alteration in market conditions of iron and steel since I last wrote. Pig iron prices are firm at recent rates, with a moderate demand for foundry sorts. There is only a small call for finished iron, marked bars selling at £14. Unmarked bars of Crown quality and nut and bolt and fencing bars are, if anything, a shade easier. The effort to raise steel prices has not been attended with additional success; £7 17s. 6d. is generally regarded as a basis for structural plates where good orders are concerned. Sections can still be bought down to £7, though most of the mills want £7 2s. 6d. to £7 5s. Bedstead angles have fallen to £9. Steel strip is obtainable at £8 upwards. Billets are firmer at £6 2s. 6d. upwards. Continental makers, after talking a long time about the necessity of higher prices, have advanced their quotations for billets 2s. 6d. per ton to £5 7s. 6d. delivered here. Foreign joists are also slightly dearer. Some producers are unable to promise delivery before March. Very little new business in galvanised sheets has been given out, but prices remain at £16 12s. 6d. For thin gauges makers are committed for a considerable time ahead. Steel scrap is firm at £3 7s. 6d. delivered South Wales, though with somewhat light business.

Midland Steel Re-rollers and Mr. Baldwin.

Few steel districts in the kingdom are more closely identified with steel re-rolling questions than the important area comprised in the district of Birmingham. Sufficient local attention has scarcely been given to the circumstance that nearly a third of the combined steel rollers who publicly manifested opposition to the extension of the Safeguarding of Industries Act to the heavy steel trade, reside in the Birmingham district. Eight of the aggregate of twenty-three firms which petitioned the Board of Trade against "Protection" for the heavy steel trade carry on business hereabouts. It is easy therefore to understand that the satisfaction which has been aroused locally by Mr. Baldwin's announcement in Parliament before the House rose for the prorogation has been very conspicuous. There is, of course, no gainsaying the argument of the re-rollers in their manifesto that not only is a large proportion of re-rolled steel produced in the United Kingdom exported directly, but that it forms the raw material for many other factories where it is made into goods, which likewise are largely exported. Employment is thus provided by the re-rollers for tens of thousands of workers, many of whom are specially trained and highly skilled men, while the capital invested in works and plant is considerable. It is equally incontestible, and is one of the strongest points of the re-rollers that the galvanised sheet section alone exports at present fully 85 per cent. of its output, and this export quantity is at the rate of about 700,000 tons per annum, valued at over £11,000,000, as against the home consumption of about 110,000 tons, or less than £2,000,000 per annum. It is considered a very strong point in the position occupied by the re-rollers that it should be possible for them to point out to-day that, notwithstanding the general world steel trade depression, the British output in 1924 was greater than in 1913, which was a boom year. Only this week some of my Birmingham friends have personally assured me that the chief trouble of the heavy steel makers is that they are suffering from excessive creation of new plant during the war, but this should right itself in time. It is added that the importation of steel semis is no new factor in the Mildand trade. There are Midland traders who unequivocally declare that they have been buying continental semis on a larger or smaller scale for nearly thirty years, and such re-rollers state to-day that the recent abnormal increase in imports has been due to the action of the heavy steel makers in buying foreign semi-steel instead of making it themselves, some of them actually closed down their steel-making plant for a time and working their finishing plant on foreign semi-raw steel.

Brighter Days for Industry in 1926.

Employers and steel masters in this part of the kingdom, to whom the question of peace in the country's industries is ever of vital importance, believe that prospects for industrial peace in the coming year the country over, in pretty nearly all branches except the coal trade, are brighter. Capitalists hereabout point out that there is distinct evidence of this in the provisional agreement just reached in the shipbuilding industry. After many months of negotiation, the Shipbuilding Employers' Federation and the unions affiliated to the Federation of Engineering and Shipbuilding Trades, have drawn up an agreement for the avoidance of disputes. A ballot of the unions is now in progress. It is remarked in the Midlands that if the scheme is accepted, it will secure more prompt consideration and settlement of questions arising in the industry without recourse to stoppages of work, which, by the admission of the unions concerned, "have in many instances caused hardship and loss to both parties to a greater extent than the amount involved in the dispute." The agreement provides for the reference of every matter in dispute, other than those connected with general wages rates, to joint references. A new feature is the appointment of an independent chairman to preside at the final court of appeal. It is regarded as unfortunate that the boilermakers and several other big unions are not parties to this scheme.

New Year Contracts.

The announcement that the London, Midland and Scottish Railway Company proposes to spend £10,000,000 in the New Year has given encouragement to Midland, in common with other steelmasters, the inference being that most of this money will be spent on steel, and that a proportion of the business will come to Midland mills. The same conclusion is drawn with regard to the £10,000,000 loan arranged by the Government in connection with the East African Railways.

The Future of Engineers' Wages.

Master engineers in the Midlands, in attempting to diagnose prospects for next year, carefully bear in mind that the engineers have yet to reach a settlement on their wages claim. They have suspended the negotiations and are co-operating with the Government in an effort to remove the handicap to British industry by the operation of longer working hours on the Continent. The Minister of Labour is moving in the matter, and the position is regarded as more hopeful, so far as continental competition is concerned. It will certainly be a most remarkable accomplishment, hardly less magnificent than the Locarno and London Pacts, if the workers of the countries of Europe, who to-day compete so severely with the engineering trades of Great Britain, are persuaded to undertake shorter working hours for the benefit of British operatives and master engineers.

Coventry Outlook.

The outlook for the motor engineering industry of Coventry is distinctly favourable. There is no shortage of home orders, and every prospect of the improvement in the export trade continuing. Moreover, the full benefits of the re-imposition of the McKenna motor car duties should be felt next year. The motor engineering shops at the moment are very busy. The past three months, ordinarily regarded as the city's quietest time, have this year provided a strenuous period in several of the most important motor factories, and the brief respite afforded by Christmas was welcome. Operations have now been resumed, and the industry has settled down to a big run, which is expected to last to Easter at least. Really wonderful strides are contemplated by many of the well-known local firms, which have made great extensions to the existing works, or have acquired further commodious premises. Additions to one of the leading factories and the installation of special plant and equipment will render an output of no fewer than 2000 motor car engines per week possible before Easter. The favourable position in the parent industry is, naturally, reflected in the associated industries, and a feeling of buoyancy predominates.

Mining Enterprise in South Derbyshire.

Boring operations are in progress at Newhall, South Derbyshire, in the hope of striking the Silverstone seam of coal. This well-known quality of coal has not hitherto been found in South Derbyshire, but it is thought likely that it will be discovered underlying already proved seams. It will probably be at considerable depth, and its discovery would add considerably to the prosperity of the district. The boring is being carried out at the Rats Yard Pit of Nadin and Co., Ltd., but other colliery companies in the district are interested in the search.

Unemployment.

As trade and commerce steps over into 1926, Staffordshire iron and steel masters and engineers recall with unalloyed gratification that there has been a continuous decline in the number of registered unemployed for some months past, and that in this respect the situation, as shown by figures given this week, shows a material improvement on that of twelve months ago. Midland manufacturers sincerely trust that the day is not far distant when the unemployed will fall far below the million level, which some people have hitherto looked upon as stabilised.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE markets here for iron and metals, as indeed for everything else, are in a state of suspense; for in the North as much notice is taken of the New Year holiday as of Christmas, and thus it will take another week to get business into order again. Indeed, in the iron and metal trades, probably nearly a fortnight must elapse, because this year the quarterly meeting at Birmingham is postponed until January 14th, and most people will wait until then before attempting to formulate any views as to the future of the trade. By that time most, if not all, of the stocktaking work will be over, and we may perhaps be able to estimate the chances of trade for the first half of the year. There are certainly hopes of some improvement, but they depend very much upon whether anything definite is done to avoid a labour struggle in the coal industry. If nothing be done now to give some assurance of the future in regard to this matter, then it is fairly certain that no very decided improvement in trade can occur.

Metals.

The market for the non-ferrous metals is still in a very hesitating condition. Looking back to the beginning of last year one finds that copper and lead are considerably cheaper now than they were then; but there is not much change in tin and spelter. The latter has been a comparatively steady metal all through the year, and although tin can never be called steady, yet it is unusual to find the price of such a metal about the same at the beginning and the end of any year. Copper has lost about £8 per ton since last January, and that upon a low level of values; lead has lost nearly £17 per ton, but, of course, lead was extravagantly dear at the beginning of 1925. The prospects for the future seem to be for fairly steady prices in copper, spelter and lead; but it is quite impossible to forecast the future of tin. All that can be said is that conditions are favourable for a high level of prices. There are still a good many people here who anticipate a return to £300 per ton for tin in the near future; although during the early part of last year, and indeed up to May, the market was a falling one, and dropped at one time below £240 per ton; and there are those who say that the experience may be repeated this year. The actual position of tin, however, is more favourable to high prices than it was was a year ago. Copper is still feeling very acutely the inability of both Germany and France to buy substantial quantities. In France the vagaries of the Exchange stand in the way, and, of course, it is possible that something will soon be done to remove this hindrance; but in Germany it is the lack of working capital which prevents any expansion in the buying of copper. There is plenty of work waiting to be done, which would absorb a large quantity of copper in Germany, and it is merely the lack of capital which is holding things back. It does not, however, seem at all probable that copper prices will become seriously lower than they now are.

Pig Iron.

Although there is practically no serious buying of foundry iron in Manchester this week, sellers are firm at the slight advance which was made when it was decided that more would have to be paid for coke. The prices are, of course, nominal, and the testing time will come when business opens in the New Year. The first Birmingham quarterly meeting in 1926 is late, viz., January 14th, and, in fact, as late as it can be under the rule of taking the second Thursday of the month; and it is very unlikely that much new business will be done until after this meeting. People will be better able then to estimate the chances of the next few months. It is probable now that the production and the consumption of foundry iron, so far as the Lancashire market is concerned, are about on a level now that Northamptonshire makes are withdrawn, and the supply is merely confined to the pig iron produced in Derbyshire and in Lincolnshire. This, of course, makes the situation rather unstable; for a slight increase on the one side or the other might make a substantial difference in price. If consumption here improves during the first three months of the year, makers of foundry iron will easily maintain their advance, and perhaps be able to exact another shilling, so as to cover completely the extra cost of coke; and so long as the price of foundry iron is not pushed beyond 75s. per ton in Manchester, there is not muchrisk of the calling into play of any of the idle furnaces; for that price is not a profitable one while coke and other production expenses are on the present level. Of course, any serious rise in pig iron prices would very soon lead to a great increase in the supply; but of this there is no probability at present. The nominal quotations for foundry iron in this market to-day are about 73s. 6d. to 74s. delivered for Derbyshire brands and 72s. 6d. to 73s. for Lincolnshire. For Scotch pig iron there was some inquiry before the holidays, and it is generally believed that this inquiry will develop again next week, because the textile machinery engineers are likely to be busier in the New Year than they were formerly. East Coast hematite iron has been a little dearer of late, but it is still a relatively cheap material.

Steel.

The feeling in the market for manufactured steel is decidedly steadier than it was. Sellers of steel plates usually quote £8 per ton now, although it is possible to buy at £7 17s. 6d. There is, however, no further rumour of sales at £7 10s. and less, as there used to be, and it is generally understood that makers of plates have abandoned the practice of "cutting one another's throats." Whether a strict price combination will be established in the Midlands is still uncertain, but the position is not so bad as it was. So long as makers do not attempt to drive prices up too high there will not be much danger from foreign steel; and possibly the experience of the iron manufacturers will make them cautious. Foreign steel can be had here at from 20s. to 25s. per ton below the British prices.

Scrap.

The market for scrap is quiet, but there is no fall in the prices, and dealers seem to be cheerful about the prospects of the New Year. All prices are more or less nominal at 52s. 6d. per ton on trucks in Lancashire for steel melting scrap; 67s. 6d. delivered at the forges for heavy wrought scrap; and 70s. to 72s. 6d. delivered at the foundries for cast scrap.

BARROW-IN-FURNESS.

Hematite.

There has been a quiet market during the holidays, but there appears to be every sign of a continuance of better trade as compared with a few months ago;

in fact, the tendency is still to improve. The fact that the improvement is slow is not a bad sign. Twelve months ago, when there was a change of Government, the iron trade suddenly showed life, and there was a hope of steady trade in some places, but the bottom dropped out of the market just as quickly as it came. There is one fewer furnace in blast at the present time than at the end of 1924, but it may not be long before the output is equal to that of a year ago. There has been more iron available this last week or two owing to the steel works being closed for the holidays, but the stock will soon be cleared, and the rail departments will soon be taking their quota. Scotch and Midland customers are showing more activity, and there is a greater tendency to place orders for forward delivery despite the stiffening in price. Continental orders are not of any magnitude, but America is likely to continue to buy.

Iron Ore.

There is more confidence in the iron ore market, and it is hoped that outside customers will place bigger orders in the future if trade continues to improve. There is greater activity at the mines than there has been for some months. The business done in foreign ores is improving, and this side of the ore trade should continue to show better imports.

Steel.

The steel market is moderately good, and there are orders to be obtained at a price. The Workington, mills will restart soon on rails, &c., and there are orders held which will keep them going three weeks out of the month. The Barrow steel works are to start next week. A few orders are held, and fresh orders are hoped for and are likely to be received. The hoop and small section mills are better circumstanced, and will be running regularly on orders held and to come.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Prospects.

It will be some weeks before the heavy trades of Sheffield get into regular swing again, and, though New Year confidence can be heard expressed on every side, there are no developments of note at the moment. Buyers in every section continue to display great caution, and in spite of favourable offers are disinclined to indulge in forward business. Steel-consuming industries in various parts of the country are nearly all reported to be improving, and if this condition continues, the revival is bound to spread to Sheffield. Owing to the scarcity of pig iron in the United States, further inquiries about delivery are being received from that country by producers here, and there is a possibility of British pig being shipped in fair quantities during the next few months. Open-hearth steel furnaces in Sheffield and district are on about the same level of production as for some time past, and the chief demand is for acid steel. Basic material is not doing at all well. Manufacturers of finished or semi-finished material, to whom a supply of cheap billets is of vital importance, are greatly relieved at the Government's decision not to take any steps towards imposing a duty on imported steel. The finishing trades use a large quantity of Swedish iron, steel billets and bars, because of their special natural qualities. The re-rollers, too, depend on buying cheap imported semi-finished material, so that they can sell it cheaply after finishing it. The whole question, however, is a controversial one, and opinion among the re rollers is divided. During the past year the number of unemployed registered in Sheffield declined by about 1700. This is not a large figure, and there are still over 20,000 persons unemployed in the city, but at least it is a move in the right direction and indicates some improvement in the local trade position.

Railways and British Steel.

The monthly report of the Sheffield Chamber of Commerce states:—"The heavy and medium trades improved in parts, and the forward position looks more promising. Steel seems bound to enter more largely into house building in the near future, the Government being disposed to assist in this line. Railway orders for material and furnishings are certain to be heavy over the next twelve months, for not only are there great extension, replacement and alteration schemes in hand, but the railway engineers are now stipulating for all-British steel as well as British finished products. Recent tests with rails, engines, wheels and so on, have demonstrated finally and emphatically that British steel is the best, and British processes most efficient. A feature of the steel trade is the decline of American competition. This may have far-reaching effects. United States exports have fallen heavily since 1920. Costs and prices are moving up month by month in America, and the steel manufacturers are planning substantial advances."

Lighter Steel Trades.

A fair amount of work is in hand in the lighter engineering and tool departments. Electrical plants are doing well, and are assured of steady working for several months. The output of files is very large, and for this and a good deal of the activity noticeable throughout the year, Russian buyers have been largely responsible. But for the orders from that country, many of the file works would have been on short time during a large part of the year. The advent of the winter season, freezing up some of the principal ports, has resulted in an easing off in the demand, but it is still good, and useful orders are now in course of execution, not only for files, but for saws and other kinds of tools. Agricultural implement makers are finding that there is a steady call for their products, and judging by the number of inquiries that are coming through, trade prospects for this year are favourable.

Cutlery and Plate.

As usual at the beginning of the year, the cutlery and plate trades are very quiet, and a fairly long holiday is being taken at the majority of the works. Hardly any orders are coming through for plated goods, and this trade is in a worse state than for many years. The 33⅓ per cent. duty which has been put on cutlery, including knives, scissors, safety razors, ordinary razors, carving forks and knife sharpeners, is now in operation, and it became operative earlier than was generally anticipated. Officially, the explanation is that the measure became operative automatically as soon as it received the Royal consent, but it is generally the opinion that the object behind this quick action was to stop articles being brought in and avoiding the duty. Of course, foreign makers had plenty of notice of what was going to happen, and they have used the time available to very good purpose. In November and December the value of the articles, now dutiable, which were rushed in, rose in a most significant manner.

Cammell Laird and Co.'s Review.

Like other firms, Cammell Laird and Co. have suffered from foreign competition and price-cutting during the past year, and in the annual review of their activities which has just been published they deal with this point, and with the depression in shipbuilding. Railway materials such as tires, axles and springs, states the review, have always been one of the company's chief lines of production, and the demand for them has been fairly satisfactory. The new tire plant at Penistone is admirably adapted to very rapid and economic production, and the Cyclops Works (Sheffield) can turn out axles with equal facility. During 1925 the railway rolling stock industry continued to suffer from the effects of the general trade depression, and the utmost that can be said is that conditions improved slightly in comparison with the previous year. Competition from continental manufacturers, possessing as they do strong advantages in respect of wages, cost of material, &c., remained very keen. In such circumstances, it is satisfactory to be able to report that the steel carriage and wagon works of the firm at Nottingham were well employed during the year, while several important orders, which will serve to keep the factory busy for some time to come, are now in hand. There was a slight improvement in the rolling stock business of the Leeds Forge Company, Ltd., but owing to keen foreign competition prices remained very low. In spite of abnormal conditions, however, the company was successful in securing a number of important orders, both for home and foreign railways. The plant for the production of pressed steel parts for rolling stock has been fairly well employed. A large number of pressed steel bogies have been supplied to the home railways for carriage stock, and a number of carriage underframes have been ordered for the Indian State Railways. The steel works, boiler furnace and plate departments have only worked intermittently throughout the year. The slump in shipbuilding is reflected in the number of corrugated furnaces made, which is somewhat less than in the preceding twelve months. The year has probably been the worst within memory for the Lancashire boiler trade, and the tonnage from the plate department has been slightly below that of 1924. There are, however, encouraging signs of an improvement in the cotton industry, upon which the Lancashire boiler trade depends to a large extent, and as so many renewals will be necessary as soon as normal conditions obtain, some improvement in this department may be confidently anticipated in the coming year.

More Colliery Output Records.

Last week I mentioned two Yorkshire pits which had set up output records and several more have to be added. At Hatfield Main Colliery, near Doncaster, 11,457 tons were brought to the surface in a week, which is 748 tons better than the previous week, and at Askern, where difficulties have been experienced, nearly 9000 tons were obtained, this also marking a considerable improvement. The best achievement of the week before Christmas was by the Denaby and Cadeby Main Collieries, with an output of 33,408 tons, and the next best was at Brodsworth. There are three shafts there, and the week's output was 28,400 tons, which, however, falls short of this pit's record. Another big figure was obtained by Bentley Colliery, which drew 26,100 tons in the week. But for an accident at Markham Main, the eighteen-month-old colliery, it is probable that a record would have been set up there. The progress made by this pit is shown by the fact that the weekly output is now round about 16,000 tons. Hull Corporation Electricity Committee has accepted tenders for 105,000 tons of coal for the requirements of the undertaking during the next twelve months. In the aggregate, the cost amounts to £75,000. The successful tenders were from A. Bannister and Co., Hull, 48,000 tons of Hickleton Main slack, 16s. 6d. per ton; Bessler-Waechter, Glover and Co., Hull, 30,000 tons of Rossington Main slack, 12s. 11d. per ton; the Midlands Coal Exports, Ltd., Hull, 27,000 tons of Hatfield Main slack, 11s. 7d. per ton. It is stated that there will be roughly a reduction of 2s. per ton in the Committee's coal bill on these prices

NORTH OF ENGLAND.

(From our own Correspondent.)

A Disappointing Year.

In reviewing the course of events in the iron and steel trade of the North of England, one is forced to the conviction that the year 1925 has been one of bitter disappointment, which has brought little or no relief from the many difficulties and embarrassments with which the industry has been beset since the post-war boom. Profits have vanished into thin air, without exception manufacturers have been unable to distribute any dividend to the ordinary shareholders, and in rare cases, where heavy losses have been avoided, manufacturing firms have been only too glad to keep their plant wholly or partically employed, without any hope of gain on the transaction. In the race for world trade manufacturers have been heavily handicapped. More dependent upon overseas markets than any of their rivals, they have had to struggle under a heavy load of financial disadvantages, not the least of which was the burden of local and Imperial taxation, to which economic history can provide no parallel. At the recent annual meeting of the Cargo Fleet Iron and Steel Company, Lord Furness estimated the burden of local rates alone as being equal to 6s. per ton on the cost of steel products, whilst in addition to the Imperial tax burden, insurance charges for health and unemployment add considerably to the weight that has to be borne. Heavy railway rates and dear fuel have also increased the handicap under which manufacturers have laboured, whilst the flight of the franc has given French and Belgian competitors an advantage which, if temporary in its effect, has been none the less a decisive factor in the struggle for business.

The Outlook.

The hopes of better trade which were entertained a year ago having failed to materialise one has, naturally, to exercise extreme caution in a forecast regarding the future of the industry, but though the difficulties which remain to be surmounted are many, though prices are depressed to an unremunerative level, and though foreign semi-manufactured material can still be bought cheaper than it can be produced in this district, there are grounds for renewed hopes of recovery in the New Year. Production costs on the Continent are rising, and there is reason to hope that Northern manufacturers may soon be grappling successfully with foreign competition. There is a better flow of general orders for constructional and railway material, but the prosperity of the steel industry is very closely allied with that of shipbuilding. The worst slump which the shipbuilding industry has ever known has hit with especial severity the many works in the North of England, which rely so largely upon orders for shipbuilding material. Some of the firms, however, have cultivated a market for steel plates for pipe lines, thus finding alternative employment for the plate mills. Indications of a revival in the shipbuilding trade are still faint, but they are discernible by the careful observer. During the past few weeks a few orders have been placed for new ships to be built on the Tyne and Wear, and from these the steel works will directly and substantially benefit.

Cleveland Iron Trade.

The optimistic feeling regarding the prospects in the Cleveland pig iron trade is fully maintained, the view that there will be a big general expansion in business in the New Year being quite pronounced. Forward inquiry is not very heavy just now, but consumers are inclined to the belief that little or nothing is to be gained by waiting, and support this opinion by their preparedness to negotiate for deliveries ahead. Producers still have to contend with considerable continental competition, but signs are not lacking that foreign manufacturers may in the near future be unable to offer such attractive terms as they have done for some time past. At a period when a general slackness in business might have been expected the market has developed quite remarkable strength. The fact is that all grades of Cleveland pig iron have become very scarce indeed. Stocks are exhausted, and although the export trade is dull, home industrial requirements have expanded in such a marked degree that the current output is scarcely adequate to meet all the calls which are being made by consumers. Deliveries are falling into arrears, and it is extremely difficult to place an order for anything like early delivery. Under the circumstances it is not surprising to find prices advancing. No doubt makers would have preferred to keep prices at the old level, but their hands have been forced by the rising cost of fuel. In less than three months blast-furnace coke has risen 4s. per ton, whereas Cleveland pig iron prices have only advanced 6d. per ton in the same period. Pig iron prices have advanced 2s. per ton, No. 1 foundry iron now being 71s.; No. 3 G.M.B., 68s. 6d.; No. 4 foundry, 67s. 6d.; and No. 4 forge, 66s. 6d. for home use. A premium of 6d. per ton is asked where iron is required for export.

Hematite Pig Iron.

Makers of East Coast hematite are in a very strong position. They have no stocks, and the increased production is proving inadequate for needs. Merchants who have iron to ship are experiencing difficulty in making up their full cargoes. Demand on both home and continental account continues on a good scale, and prices are steadily moving upward. Some of the makers now quote 77s. per ton for mixed numbers, and 76s. 6d. is certainly a minimum figure, while No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

Deliveries of foreign ore have recently been delayed owing to the bad weather, but heavier shipments are now on the way. New business at the moment is quiet, but the price is steady at 21s. per ton for best Rubio ore c.i.f. Tees. The coke market is firm with supplies scarcer than ever, owing to the holidays. Good blast-furnace kinds are still quoted at 22s. 6d. per ton delivered works for January.

Manufactured Iron and Steel.

There is no fresh development in the manufactured iron and steel trade, but the outlook is promising, and prices are inclined to firmness.

The Coal Trade.

The holiday feeling has predominated in the Northern coal trade this week, and actual transactions have been very few, but prices continue firm in all sections. The collieries have good stems up to the middle of January, and at the moment tonnage arrivals are satisfactory. Forward quotations are quite steady and are likely to continue so, in view of the curtailed production of last week and this. There is a fair number of inquiries circulating, but the difficulty is to get loading turns to suit customers. Best Northumberland steam coals are sold out for prompt dates, and a good request is expected for forward supplies. Best Blyth grades are quiet but fully firm at 15s. 3d. to 15s. 6d., while Tyne primes are keeping to 14s. 9d. and seconds to 14s. 3d. to 14s. 6d. Steam smalls are steadily maintaining 9s. 6d. for bests, 8s. 6d.

for seconds, and 9s. 9d. for special makes. For the time being, there is a pause in the business of the Durham, markets, and prices remain unaltered. The position, however, is strong under very good bookings, and the trend of things is with sellers. Best gas coals are in short supply and firm at 16s. 6d., while Wear specials maintain 17s. 3d. to 17s. 6d., and seconds 15s. 3d. to 15s. 6d. Some sellers are inclined to ask higher values than these. There is little fresh business passing in the coke trade, but the position is very firm. Production for the first half of January has been taken up at good prices, and current quotations range strongly at 24s. to 25s. for gas makes, 21s. to 23s. for patent oven sorts, and 30s. to 32s. for beehive brands.

SCOTLAND.

(*From our own Correspondent.*)

Holiday Markets.

SINCE the middle of last week a holiday feeling has pervaded the steel, iron and coal markets, and business has been practically at a standstill. The rush for supplies over the holidays, usually experienced at this season of the year, has been conspicuously absent. In all probability many factories will be closed for a longer period than usual, owing to the dearth of orders. In some instances, however, orders are withheld in view of stocktaking, which many concerns carry out prior to the New Year stoppage.

Steel and Iron.

The weakness in the steel and iron markets continues, and it seems probable that a further decline in prices will follow. So far as new business is concerned, nothing has happened which is likely to create any degree of optimism with regard to the future, and the general outlook is most unsatisfactory. The decline in shipbuild ing has had a direct effect on local steel and iron industries, which also suffer from severe continental competition. The situation in the shipbuilding industry, so far as the Clyde is concerned, is not very much better, and steel and ironmakers cannot anticipate an early improvement in demands from that source. Consequently, the outlook for plates and sections is not particularly bright. Competition in foreign markets has made export business extremely difficult, local producers being quite unable to quote competitive prices. Steel sheets have for a considerable period been the only satisfactory feature in the steel market, and the position is still unchanged in that respect. Black sheets of thin gauge have been well booked up, and some makers have sufficient business on hand to provide employment for some months ahead. Galvanised sheets also have been active for export, and a firm level of prices has been established. Bar iron has been a comparatively poor proposition. Both home and shipping demands have been far below normal, and reductions in price have failed to bring out any increase in business. The present quotation of £11 5s. per ton for Crown quality bars is still too high to induce buyers to purchase beyond small actual requirements. The re-rolled steel department has occasionally been busy, but orders could only be secured when sacrificial prices were offered.

Pig Iron.

The pig iron trade has suffered in company with, and as a result of the slackness in, the steel and iron industries. Both hematite and foundry qualities have been in poor demand throughout the year, and outputs have been cut down as far as possible. Many works are merely producing sufficient to keep stocks on a safety level, against any sudden demand. Prices have fallen since last January by about 17s. 6d. per ton in the case of hematite, and from 10s. to 15s. per ton in foundry qualities.

Coal.

Business in the coal market has been more or less at a standstill during the past two weeks, as supplies were almost entirely taken up against commitments falling due prior to the New Year. Only small parcels to complete cargoes could be obtained, and very firm prices had to be paid for any such accommodation. A number of steamers have arrived, and it is questionable if all will receive cargoes before the holidays. Aggregate shipments amounted to 214,165 tons, against 294,804 tons in the preceding week and 277,240 tons in the same week last year. Home demands are very moderate so far as industrial fuels are concerned, but household and municipal demands are heavy. Business on hand for January is meagre, as neither buyers nor sellers are anxious to commit themselves.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Coal Trade Review.

FROM the point of view of all concerned in the Welsh coal trade, and referring more particularly to the steam coal section, the past year was distinctly disappointing. The workmen had a bad time, their wages being down to the minimum, and their employment extremely irregular. Coalowners and shareholders received no return on their capital, except in the case of a few isolated undertakings, while exporters are fortunate if, on the year, they have come out all square, inasmuch as the majority must have made losses if they contracted in the autumn of 1924 for supplies of coal for delivery over 1925. The story of 1925 is one of almost unrelieved depression. Almost from the very beginning trade fell off and prices steadily sagged until best Admiralty large coal declined from 27s. 6d. to as low as 22s. 6d., while superior smalls dropped from 17s. to as low as 10s. per ton. Continental competition, and American too, was keen, and South Wales coalowners were compelled to make cut after cut in prices with a view to getting business and retaining their markets. There seemed to be no limit to which prices must go in order to secure orders to keep pits working, and it was not surprising that coalowners in a number of instances had to shut up their pits, as they could not stand the losses they were incurring. An official return shows that as many as ninety pits were closed in this district during the year, many of which will probably never reopen. It was common to find during the first eight months of the year that anything from 40,000 to 50,000 miners were idle at a time at various collieries. Complete figures are not available as yet as to the exports for 1925, but it is a safe estimate to put the reduction, as compared with 1924, at over 4,000,000 tons. Apart from the market side of the industry and the conditions prevailing in the coalfield generally, main interest during the year was centred in the action of the Government in granting a subvention to the industry. The details of this scheme, however, were arranged so hurriedly that the method of its application has left much to be desired. The whole district is treated as one unit, and consequently collieries which were able to work more economically still retained their position of advantage as compared with their neighbours, and it is very doubtful whether the scheme has served the purpose intended to any appreciable extent, as only in very isolated cases have pits been able to resume operations as the result of the subsidy. One fact is certain, and that is that the foreign consumer reaped an advantage. Buyers held off persistently, and during the first two months during the operation of the subvention market prices fell off more sharply than at any time during the whole year, inasmuch as they gave way from 3s. to 4s. per ton. The last quarter of the year showed signs of some improvement in trade, and the prices of small coals recovered substantially as best qualities rose from 10s. to 15s. The outlook, however, for the New Year is none too bright, and the uncertainty as to what will happen when the subsidy comes to an end in May is so great that business for 1926 is being considerably handicapped.

Coal Inquiries.

Since I wrote last week it has been reported that Lloyd's Braziliero has contracted with Cory Brothers and Co., Ltd., for the supply of 100,000 tons of Admiralty large coals, while, in addition to the inquiry from the Navagazione Generale Italiana for 90,000 tons of Admiralty large for shipment during the first five months of 1926, the Madrid, Zaragosa and Alicante Railway of Spain has asked for tenders for 35,000 tons of Admiralty large for shipment over the first half of next year, and the Norte Railway of Spain is in the market for 22,000 tons for delivery by the end of March.

Current Business.

The current demand for coals is on moderate lines, though the demand for Italy is improving. The near continental demand is quiet. The market has scarcely settled down from the holidays, though prices are on the whole much about the figures prevailing last week. There was, of course, a considerable exodus of tonnage immediately before the vacation, and bad weather has since then resulted in tonnage getting out of position and being delayed so that the docks are not so well supplied with steamers as was expected. Taking the ports of Newport, Cardiff, Penarth and Barry, there were twenty-five vacant loading berths on Monday, and it is to be feared that supplies of tonnage will continue to be on the short side for some little time, as the amount of tonnage recently taken up is below the average, and supplies on offer for prompt positions are far from plentiful, so far as steamers of 5000 to 7000 tons are concerned. The market for anthracite coals continues to be very steady at the late level.

Iron and Steel and Tin-plate Items.

The South Wales and Monmouthshire Iron and Steel Workers' Wages Sliding Scale audit has just been announced for the three months ending November 30th, and shows that the average net selling price of steel rails—20 lb. per yard and upwards—and steel tin bars for the period was only £6 14s. 3.76d. per ton. This figure represents a decline of 10s. per ton compared with that for the period ending August 31st, and the effect on the wages sliding scale is a fall of 5 per cent., which operates from January 1st. Until the end of March the scale will therefore stand at 47 per cent. above the standard. The sub-committee of the South Wales Tin-plate Conciliation Board dealing with the application for an increase in wages of 15 per cent. for tinmen met at Swansea on Monday. The proceedings were private, but it is understood that the application was referred to the Standing Joint Committee of the Board for final consideration.

Prospects of Collieries Restarting.

As the result of a meeting of the management of the Cwmcarn and Abercarn Collieries, belonging to the Ebbw Vale Company, with the workmen's committees, there is a prospect that work will be resumed at these pits by the end of this week. About 2000 workmen are affected. Negotiations are also proceeding on new lines to bring about a restart of work at the Clydach Vale pits, belonging to the Cambrian Combine, and there appears to be more optimism prevalent as to the issue.

Dry Dock Amalgamation.

Circulars have now been issued to the shareholders in the Mountstuart Dry Docks and Shearmans, Ltd., informing them that the present chairman and managing director of the Company, Mr. Frank Shearman, has parted with the bulk of his interest in the company to Elliot and Jeffery, and that arrangements have been come to, subject to the approval of the shareholders, for acquiring the undertaking of Elliot and Jeffery, Ltd., which owns the Windsor Slipway and Engineering Works at Cardiff and Barry. At the same time, a material reorganisation of the capital of the Mountstuart undertaking is proposed. It is proposed to reduce the value of the Mountstuart preferred and deferred ordinary shares by one-half, by writing off 10s. per share, and simultaneously to increase the authorised capital by the amount written off, in order that part of the latter may be issued on account of the purchase consideration of Elliot and Jeffery's undertaking. It is further proposed to make an issue of second debentures in further consideration of the purchase. The purchase price of Elliot and Jeffery's undertaking, valued at £125,000, is £100,000, but the stock and loose plant, dredgers and gear are to be taken over at a valuation for cash, which will form the only cash payment. Mr. John Elliot will become the new chairman and managing director of the combined undertakings in place of Mr. Frank Shearman, who will, however, retain a seat on the board.

CALENDARS, DIARIES, &c.

HENRY SIMON, Ltd., Manchester.—Desk calendar with daily tear-off sheets.

THE MARCONI COMPANY, Strand, W.C. 2.—Calendar with monthly tear-off slips.

WILLIAM BEARDMORE AND CO., Ltd., Glasgow.—Wall calendar with monthly tear-off sheets.

A.D.C. AIRCRAFT, Ltd., 89, Kingsway, W.C. 2.—Card showing picture of aeroplane in flight.

LONDON CHAMBER OF COMMERCE, Cannon-street, E.C. 4.—Calendar with daily tear-off slips.

R. Y. PICKERING AND CO., Ltd., Wishaw, Scotland.—Wall calendar with monthly tear-off sheets.

NOAKES BROS., 19, St. Bride-street, Ludgate-circus, E.C. 4.—Art calendar with daily tear-off sheets.

HULSE AND CO., Ltd., Ordsal Works, Manchester.—Wall calendar with monthly tear-off sheets.

GEO. CRADOCK AND CO., Ltd., Wire Rope Works, Wakefield.—Wall calendar with monthly tear-off sheets.

THE LAW LAND BUILDING DEPARTMENT, Ltd., 30, Norfolk-street, Strand, W.C. 2.—Pocket diary for 1926.

VICKERS LTD., Vickers House, S.W. 1.—Pocket diary for 1926.

"THE CHEMICAL TRADE JOURNAL AND CHEMICAL ENGINEER."—Wall calendar with monthly tear-off sheets.

NEWTON, CHAMBERS AND CO., Ltd., Thorncliffe Ironworks, near Sheffield.—Wall calendar with daily tear-off sheets.

SURVEYORS' TABLES AND DIARY, 1926.—Published by Metchin and Son, 8, Princes-street, Westminster, S.W. 1.

INTERNATIONAL CONSTRUCTION COMPANY, Ltd., 56, Kingsway, W.C. 2.—Wall calendar with monthly tear-off sheets.

C. TOWNSEND HOOK AND CO., Ltd., 102–4, Queen Victoria-street, E.C. 4.—Art calendar with monthly tear-off sheets.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., Newcastle-on-Tyne.—Wall calendar with monthly and daily tear-off slips.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE address of the London representatives of Messrs. J. H. Williams and Co., Buffalo, N.Y., U.S.A., is now Benjamin Whittaker, Ltd., Aldwych House, Aldwych, W.C. 2.

MR. C. BENTHAM, M.I. Mech. E., one of the directors of Henry Simon, Ltd., was, at the annual meeting of the Manchester District Engineering Trades Employers' Association, elected a member of the executive committee of that body.

MR. C. HOLMES WAGHORN, A.M. Inst. C.E., asks us to state that he has resigned his position of general manager of Walker Vehicles, Ltd., but that letters addressed to him, care of Walker Vehicles, Ltd., Clare House, Kingsway, W.C. 2, will be forwarded to him.

HADFIELDS, Ltd., of Tinsley, Sheffield, informs us that it has just been appointed as official contractor for stone-crushing plant to the Irish Free State, to county surveyors in which it has, during the last seventeen months, supplied nineteen complete portable crushing plants.

THE Waterworks Committee of the Keighley Town Council has recommended that Mr. M. Ratcliffe Barnett, M. Inst. C.E., who has been engineer of the New Sladen Valley waterworks for Keighley, be appointed permanent waterworks engineer to the Corporation as from July 1st, 1926.

THE PNEULEC MACHINE COMPANY, Ltd., of Mafeking-road, Smethwick, near Birmingham, asks us to announce that it has purchased the constructional plant of Thwaites Bros., Ltd., of Bradford, and that the plant is being transferred to its Smethwick works, where considerable extensions are being carried out

WE are asked to state that, owing to family reasons, it has been decided to convert the business of E. P. Allam and Co., Ltd., of 107–109, Gray's Inn-road, London, W.C. 1, into a private limited liability company. On and after to-day the business will be carried on under the style of E. P. Allam and Co., Ltd., but there will be no alteration in the management and staff.

WE are informed by the Gear Grinding Company, Ltd., Birmingham, that it has completed arrangements by which a Gear Grinding Company has been established in Milan, Italy. This company will be known as the Società Italiana Rettifica Ingranaggi (S.I.R.I.). The works will be equipped with the Gear Grinding Company's special tooth grinding machines. The plant will be operated on similar lines to those employed in the Birmingham shops. The new Italian company has purchased the sole rights for the use of the Gear Grinding Company's patents and process in Italy.

CONTRACTS.

JOSEPH KAYE AND SONS, Ltd., of Leeds, inform us that they have received a further order for their patented force-feed oil cans from the British Admiralty.

INTERNATIONAL COMBUSTION, Ltd., of Africa House, Kingsway, informs us that its associated company of France has recently received orders for the installation of Lopulco pulverised fuel equipment from the Société Intercommule Belge d'Electricite, the Holland State Mines, and from the Haut Katanga Company.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., has received an order from Pearson and Dorman Long, Ltd., for an installation of automatic electro-pneumatic decking plant at the No. 3 pit of the Snowdown Colliery, Kent, for both the pit top and the pit bottom, including power-operated gates in each case.

WHITWORTH SOCIETY.—The third annual commemoration dinner was held at the Holborn Restaurant on Monday, December 21st, 1925, the anniversary of the birth of Sir Joseph Whitworth, Bart., with the President, Mr. Wm. Sisson, of Gloucester, in the chair. About seventy members were present. There are now 470 members on the roll of the Society, of which full information may be obtained from the hon. secretary, care of Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	21/-
(1) Spanish	18/6
(1) N. African	18/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 6	—
No. 1 Foundry	3 19 6 to 4 2 0	
No. 3 Foundry	3 17 6 to 3 19 0	
N.E. COAST—		
Hematite Mixed Nos.	3 17 0	3 17 0
No. 1	3 17 6	3 17 6
Cleveland—		
No. 1	3 11 0	3 11 6
Silicious Iron	3 11 0	3 11 6
No. 3 G.M.B.	3 8 6	3 9 0
No. 4 Foundry	3 7 6	3 8 0
No. 4 Forge	3 6 6	3 7 0
Mottled	3 5 6	3 6 0
White	3 5 6	3 6 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 2 0 to 3 2 6	
,, Forge	2 15 0 to 2 16 0	
(3) Derbyshire—		
No. 3 Foundry	3 6 6 to 3 7 6	
Forge	3 1 0 to 3 2 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 8 0 (a) / 4 10 6 (b) / 4 15 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	—
Best ,,	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	11 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 10 0 to 12 0 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 10 0 to 11 0 0	
Gas Tube Strip	12 10 0 to 12 15 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¼in. and up.	7 10 0 to 7 12 6	
Sections	7 0 0 to 7 2 6	
Steel Sheets, under 3/16in. to ¼in.	9 2 6 to 9 5 0	
Sheets (Gal. Cor. 24 B.G.)	—	18 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 5 0	—
Angles	6 17 6	—
Boiler Plates	11 10 0	—
Joists	6 17 6	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light ,,	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
MANCHESTER—		
Bars (Round)	8 5 0 to 9 0 0	
,, (others)	8 0 0 to 8 10 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	7 17 6 to 8 5 0	
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0 to 11 0 0	
MIDLANDS—		
Small Rolled Bars	7 17 6 to 8 0 0	
Billets and Sheet Bars	6 2 0 to 6 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 12 6 to 16 15 0	
Angles	7 2 6 to 7 7 6	
Joists	7 2 6 to 7 7 6	
Tees	8 2 6 to 8 7 6	
Bridge and Tank Plates	7 17 6 to 8 0 0	
Boiler Plates	11 0 0 to 12 0 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 20/-
Block Tin (cash)	287 0 0
,, (three months)	280 0 0
Copper (cash)	59 5 0
,, (three months)	60 7 6
Spanish Lead (cash)	35 7 6
,, (three months)	35 3 9
Spelter (cash)	39 0 0
,, (three months)	37 18 9
MANCHESTER—	
Copper, Best Selected Ingots	65 5 0
,, Electrolytic	67 0 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
,, Condenser	0 1 2½
Lead, English	36 10 0
,, Foreign	35 10 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/8 to 1/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 0 0	7/9
,, 8 p.c. to 10 p.c. ,,	£22 10 0	7/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£40 10 0	15/-
,, ,, 1 p.c. ,,	£50 0 0	17/-
,, ,, 0·70 p.c. carbon	£56 10 0	19/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	3/9 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£24 0 0 scale 6/- per unit	
,, Vanadium	15/6 per lb.	
,, Molybdenum	6/3 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£172 to £177	
Cobalt	10/- per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/6
,, ,, Ell	18/9
,, ,, Splint	17/- to 19/-
,, ,, Trebles	17/9
,, ,, Doubles	16/9
,, ,, Singles	15/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	15/6
,, ,, Splints	17/-
,, ,, Trebles	17/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/- to 15/6
Screened Navigation	20/9
Trebles	18/- to 19/-
Doubles	16/6
Singles	15/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/3
Secondary Steam	14/9
Trebles	18/9
Doubles	16/6
Singles	15/-

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	23/6
Household	40/- to 45/-
Coke	26/-
NORTHUMBERLAND—	
Best Steams	15/6
Second Steams	14/6
Steam Smalls	9/6 to 10/-
Unscreened	14/-
Household	20/- to 22/-
DURHAM—	
Best Gas	16/- to 16/6
Second	14/6 to 15/-
Household	20/- to 22/-
Foundry Coke	20/- to 22/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	31/- to 34/-
Barnsley Best Silkstone	28/- to 30/-
Derbyshire Best Brights	26/- to 27/6
,, ,, House	24/- to 25/-
,, ,, Large Nuts	17/- to 20/-
,, ,, Small	12/6 to 14/-
Yorkshire Hards	16/6 to 19/6
Derbyshire ,,	18/- to 19/-
Rough Slacks	10/- to 12/6
Nutty ,,	7/6 to 9/-
Smalls	3/6 to 6/-
Blast-furnace Coke (Inland)*	—
,, ,, (Export) f.o.b.	19/3 to 19/9

(9) SOUTH WALES.

	Inland.
CARDIFF—	
Steam Coals :	
Best Smokeless Large	23/- to 23/6
Second ,, ,,	22/- to 22/6
Best Dry Large	22/- to 22/6
Ordinary Dry Large	20/6 to 21/6
Best Black Vein Large	20/- to 20/6
Western Valley Large	19/- to 20/-
Best Eastern Valley Large	19/- to 19/6
Ordinary ,, ,,	18/9 to 19/-
Best Steam Smalls	13/6 to 14/6
Ordinary ,,	11/- to 13/-
Washed Nuts	19/- to 28/6
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	17/- to 18/-
No. 2 ,, Large	19/- to 20/-
,, ,, Through	16/- to 17/-
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	37/6 to 40/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	20/- to 23/-
Pitwood (ex ship)	29/- to 29/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	40/- to 42/6
Seconds	32/6 to 36/-
Red Vein	29/- to 32/-
Machine-made Cobbles	55/- to 57/6
Nuts	55/- to 57/6
Beans	42/6 to 45/-
Peas	20/- to 24/-
Breaker Duff	8/- to 8/6
Rubbly Culm	11/9 to 12/3
Steam Coals :	
Large	22/- to 23/6
Seconds	20/- to 22/-
Smalls	9/6 to 10/6
Cargo Through	16/6 to 18/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market, 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Rail Union

THE negotiations for the constitution of a Comptoir of French rail makers were practically completed by the end of last week, and if certain details are settled in time the convention is to come into operation to-day. The new body will not only control the production of rails but also the prices. This step was taken in view of the forthcoming meeting in London, where it is hoped that it will now be possible to form the International Union. The situation has become so critical, through the European production of rails being far in excess of requirements, that ruinous price cutting can only be avoided by a general organisation. It is even hoped that what has been done will result in the creation of a great Steel Union which is strongly favoured by the majority of French producers.

Colonial Works.

The programme of public works to be carried out in West Africa is of too vast a character to permit of its being put in hand with the financial resources at present available, but the development of trade during the past few years has provided the colonial administration with the means of starting upon at least some of the more urgent undertakings. During the next three years, therefore, a large amount of useful work will be done in improving railway facilities, providing better accommodation at existing ports and creating new ones, and in constructing barrages for the irrigation of vast cotton growing areas in the Niger Valley. The first thing to be done is to increase the carrying capacity of the railways which are generally found to be incapable of dealing with the traffic satisfactorily. The line from Thiès to the Niger has a metre gauge and is of far too light construction, with heavy gradients and sharp curves, and in view of the difficulties experienced with this railway since it was opened two years ago, it has been decided to relay a part of it with reduced gradients and heavier rails, to carry heavier rolling stock. The Ivory Coast Railway, which is working for a distance of 371 kiloms., will also be strengthened and consolidated, and will be extended northwards to the Sudan and the Upper Volta, where it will reach populous regions possessing great agricultural wealth. The railway between Porto-Novo and Kotonou, in Dahomey, has been started upon, and is expected to offer considerable engineering difficulties because of the necessity of constructing long viaducts across the lagoons. Railways are also to be constructed in Senegal to bring it into communication with the Dakar-Saint-Louis and the Thiès-Niger lines, and generally communications will be established to permit of products being conveyed from over extensive areas to the ports for shipment. At all the ports dredging operations will be carried out and wharves constructed. A particularly interesting undertaking is the construction at Sotuba between Bamako and Koulikoro of a barrage, which will be the first step in the carrying out of an irrigation scheme for the growth of cotton.

The Rove Tunnel.

The tunnel through the Nerthe Range, which is to put Marseilles into communication with the Etang de Berre and the Rhone is now completed, except for the monumental stone portals to be constructed at each end. A description of the tunnel was published in these columns in 1923. Having a width of 22 m. and a height in the centre of 11.40 m. above the level of the canal, it has the largest section of any tunnel yet made. Its length is 7120 m., and the quantity of spoil removed was two and a half million cubic metres, or more than twice the amount extracted from the double Simplon Tunnel. Started in March, 1911, the work continued without interruption, even during the war, and the cost is approximately 120 million francs, the greater part of which has been paid by the Marseilles Chamber of Commerce. The object of the Rove Tunnel is mainly to continue the waterway communication from the Rhone, when that river is canalised, to Marseilles, by way of Arles, so that Marseilles will be at the end of the future canal system which will enable 600-ton boats to reach Central Europe. It is expected that the tunnel will be put into service during the first half of the present year.

Strikes in Belgium.

The efforts to stabilise currency in Belgium are having the effect of restricting momentarily the export trade, and the situation is causing trouble in the iron, steel and engineering trades, in which wages disputes have assumed serious proportions. The strike of iron and steel operatives in the Charleroi district has lasted more than six months, and there is, as yet, no indication of its coming to an end. All its efforts to bring about a settlement having failed, the Government has now decided to take strong measures to put an end to a situation which is involving the country in serious loss, alike in the consumption of coal and in the diminution of iron and steel exports. If the employers and men are unable to settle the dispute by conciliation, the Government will insist on its being submitted to arbitration, with the threat that if the men refuse they will be left to their fate, and if the employers decline arbitration the State will offer financial aid to the men. In the colliery industry the temporary arrangement entered into between coalowners and miners is coming to an end, and unless some satisfactory basis for the future adjustment of wages is come to the whole dispute will be reopened. The coalowners affirm that unless wages are reduced they will be unable to resist the world-wide depression in the coal trade. As a compromise they now claim a reduction of 3 per cent. instead of the 5 per cent. previously demanded. This will remain in force for two months, when a new scale of wages will come into operation depending upon the selling prices of coal. The outlook appears so hopeless from the miners' point of view that it is believed they will accept the coalowners' proposal.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

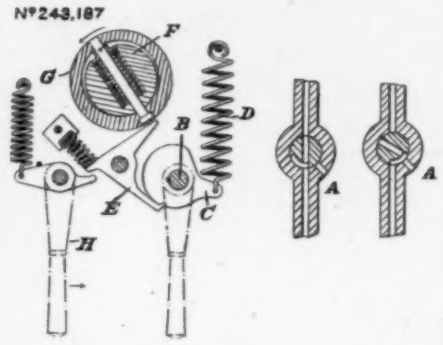
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

243,187. January 1st, 1925.—RUN-AWAY GOVERNORS, G. Arrowsmith and Hick, Hargreaves and Co., Ltd., Soho Ironworks, Bolton.

This emergency or run-away governor operates on the pressure oil supply to the main steam valve. In the oil pipe there is arranged a plug cock A, which, as will be seen from the two views, provides either a free passage or shuts off the oil, and, at

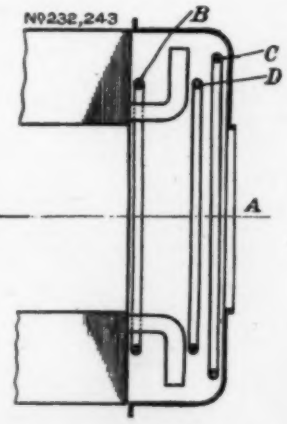


the same time releases the pressure to atmosphere. The plug of this cock is connected with the shaft B on which there is keyed the cam C. The cam may be pulled round by the spring D, but is held by the trigger E. If the speed of the turbine shaft F exceeds safe limits, the out-of-balance ring G strikes the trigger E and releases the cam, which, in rotating, pushes the trigger clear of the rotating ring. The lever H is for tripping the gear by hand.—*November 20th*, 1925.

DYNAMOS AND MOTORS.

232,243. April 9th, 1925.—PROTECTIVE ARRANGEMENT FOR ALTERNATING-CURRENT ELECTRIC MACHINES, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.

This invention relates to a protective arrangement for alternating-current machines, which protects the machine in a

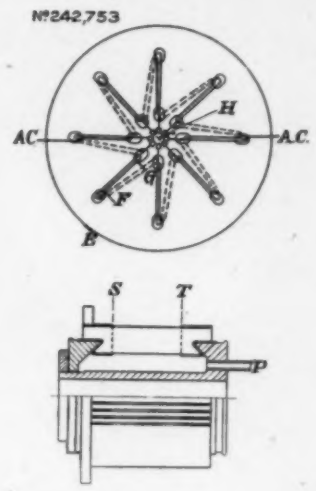


reliable manner from short circuits. The dispersion or leakage fields of the machine are utilised for operating release devices. The drawing shows the end of a dynamo. Within the winding head and arranged concentrically with the machine axis A there is a leakage field coil B which is connected to the release device. C and D indicate leakage field coils outside the winding head.—*November 19th*, 1925.

TRANSFORMERS AND CONVERTERS.

242,753. September 6th, 1924.—IMPROVEMENTS IN APPARATUS FOR CONVERTING ELECTRIC CURRENTS, Wyatt Meacher, of the Westminster Engineering Company, Ltd., Victoria-road, Willesden Junction, N.W. 10.

The invention relates to a method of converting from alternating to direct current or from direct to alternating current by using a stationary iron circuit in connection with one or more commutators and mechanically revolving brushes. Hitherto it has been proposed to effect this by means of a winding embedded in slots in separate concentric rings, air gaps being introduced in the magnetic circuit at the junction of the rings. According to this invention the iron circuit consists of laminated discs or rings with two series of holes pierced in the discs or rings through which conductors are wound as shown. These two series of holes or oval slots are spaced so that the depth of the ring of iron from F to G between these holes is approximately double the depth of the iron E to F between the outer series of holes and the outer edge of the iron ring or disc and also double that between the inner series of holes and the inner edge of ring or centre of disc H. The conductors are wound from the outer to the inner series of holes forming an ironclad ring winding so as to reduce the magnetic leakage and to give the maximum effect by using a double magnetic circuit. Both the alternating-current and direct-current windings are uniformly spread and the direct-current coils are subdivided as much as possible with a view to avoiding pulsation in the generated electromotive force and to give uniform commutation. The alternating-current coils can be wound in alternate slots to the direct-current coils or they can be wound in the same slots one over the other or with one winding sandwiched between two or more portions of the other, tappings being taken to the commutator bars as shown. Alternatively where the desired voltage ratio permits, the direct-current system can consist of a number of tappings from the alternating-current winding brought down to the commutator bars. The apparatus can be wound so as to give either two-pole or multipolar direct-current windings which can be either lap or wave connected. The same alternating-current winding can be used in connection with one or more direct-current windings superimposed and connected to two or more commutators which can be used in series or in parallel. The commutators can be constructed with either vertical or horizontal bars and for high voltages can be built as shown in the lower illustration with

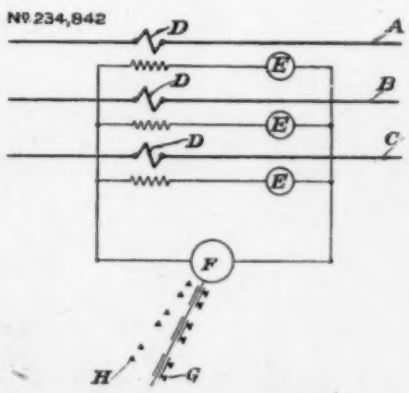


mica or some other insulating strips at each end of the bars projecting well beyond the surface of the copper bars on both sides, so leaving an air space between the copper bars in the portion S to T over which the carbon or metal brushes move. The insulated bush carrying this type of commutator would be air-tight and connected to a pipe P supplying compressed air so as to suppress any arcing at the brushes at high voltages. To convert alternating current to direct current it is necessary to have the brushes rotating at a speed synchronous with the alternating-current supply frequency and they are therefore driven by a synchronous motor with suitable means for adjusting the brush position. To convert direct current to alternating current the brushes can be driven by a direct-current motor which can be varied in speed to suit the desired frequency of the alternating-current circuit.—*November 19th*, 1925.

ELECTRICAL APPLIANCES.

234,842. May 29th, 1925.—PROTECTIVE ARRANGEMENTS FOR ALTERNATING ELECTRIC CURRENT CIRCUITS, *The International General Electric Company, Incorporated, of* 120, *Broadway, New York.*

In each of the three phases A, B, C of a three-phase system a current transformer D is placed, and in series with it the current coil of an excess current relay E which possesses, in addition, a voltage coil, not shown. The currents of the three phases are carried to a relay F in the known asymmetrical connection. So long as the sum of the phase currents is zero no current flows into this relay. This is the case in normal working or with a



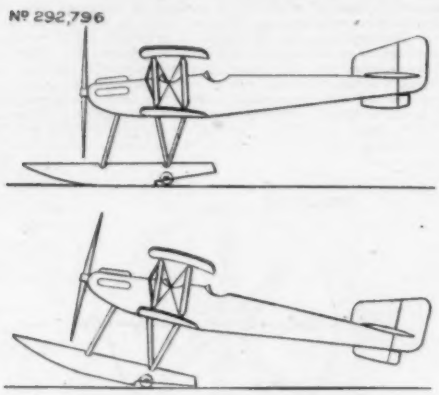
short circuit between two or three phases. So long as the relay F is not energised the three pairs of contacts G are kept closed. If the equilibrium of the three currents is disturbed, which occurs with an earth fault, the relay F comes into operation and closes the contact pairs H. The voltage coils of the relays E are arranged in such a manner that they are connected by means of the contacts G to the line voltages and by means of the contacts H to the voltages of the respective phases. Thus, when the relay F is without current the relays E then carry the line voltages, and when the relay F is traversed by current (as in the case of an earth fault) the relays E carry the phase voltage.—*November 19th*, 1925.

AERONAUTICS.

202,796. November 26th, 1924.—LANDING DEVICES FOR SEAPLANES, C. H. Fairey, Cranford-lane, Hayes, Middlesex.

It is asserted in this specification that it has been found possible to land seaplanes, devoid of wheels, on the decks of ships and on other alighting places presenting a substantially smooth surface; but, when once thus landed, a wheelless seaplane cannot be handled conveniently until it has been lifted on to a wheeled trolley or the like, an operation which involves a good deal of trouble and requires considerable time. The primary object of the invention is to provide an improved construction enabling the use of a wheeled trolley or the like to be dispensed with, whether the landing be effected on a ship's deck or other suitable

surface; this object being attained without causing such increased head resistance in the water as is usually found in sea-planes having amphibian or quasi-amphibian floats. The

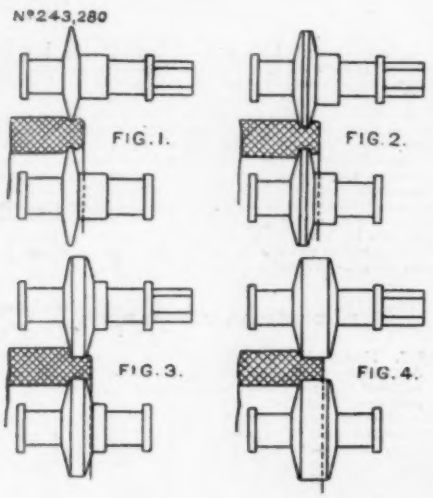


arrangement is so obvious in the illustration, which shows the machine alighting, above, and being wheeled about below, that no further description is necessary.—*November* 19*th*, 1925.

MACHINE TOOLS AND SHOP APPLIANCES.

243,280. July 15th, 1925.—MANUFACTURE OF SEAMLESS TUBES, M. Roeckner, 5, Scheffelstrasse, Mülheim-Ruhr, Germany.

This invention relates to the production of seamless tubes, from a pierced ingot, by means of a rolling process analogous to that used in drawing down a billet under the steam hammer. The machine, which is described in the specification, comprises four pairs of rolls. One roll of each pair is inside the tube and

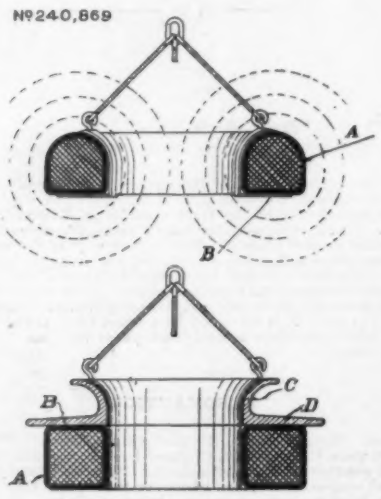


the other outside. As shown in the illustration, one pair of the rolls cuts a nick in the wall of the hollow ingot, a short distance from the end, and this nick is widened out by the other rolls, so that the metal is extended longitudinally. The last pair of rolls smooths out the extended metal. By arranging the rolls helically round the tube and giving them a slight cant the process is made continuous.—*November* 26*th*, 1925.

MISCELLANEOUS.

240,869. October 5th, 1925.—IMPROVEMENTS IN AND RELATING TO LIFTING MAGNETS, *The International General Electric Company, Incorporated, of* 120, *Broadway, New York.*

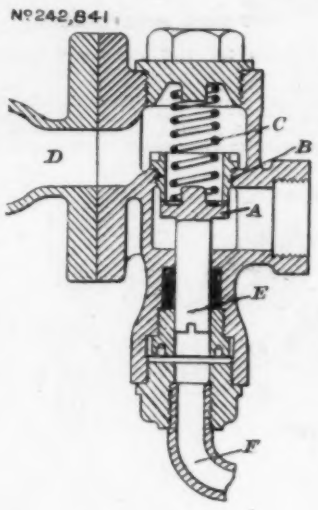
Lifting magnets are used for lifting simultaneously materials of widely different kinds, but it is found that a magnet weighing



500 kilos. that will lift an iron block weighing 4000 kilos. will only lift 100 kilos. to 200 kilos. of scrap. According to this invention, however, this drawback is eliminated by constructing the magnet with an ironless core. In the drawing A is an annular solenoid surrounded by a non-magnetic material B for protecting it from mechanical injury, the magnetic field being indicated by the dotted circles. In the lower illustration the solenoid is also provided with an iron tube C and an annular projecting flange D. When the solenoid is placed on the material to be lifted, for instance, scrap, and the current is switched on, the scrap is drawn into the ring and adheres to its surface. In this way an electromagnet will be formed in which the core does not constitute a dead weight, but a useful load.—*November* 19*th*, 1925.

242,841. February 24th, 1925.—INJECTORS, R. G. Brooke, Upton Grange, Macclesfield.

This overflow valve for injectors is claimed to be more simple and convenient for overhaul than are those usually fitted. The valve A works in conjunction with a screwed-in seating B and



is normally held open by a spring C so that there is a free outlet to the overflow chamber D. The stem of the valve is extended at E to form a piston, and this piston is subject to the delivery pressure of the injector by way of the connection F, in order to close the valve when the injector starts working.—*November* 19*th*, 1925.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Cinematograph lecture, "The Manufacture of Ordnance, and the Rolling Mills and Crucible Melting Department at the River Don Works of Vickers, Ltd." 7.30 p.m.

TUESDAY, JANUARY 5TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Sleeve Valve Engine Development," by Mr. W. Ferrier Brown. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "The Development of the Two-stroke Cycle," by Mr. E. W. Coy. 7.15 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Chamber of Commerce, New-street, Birmingham. Paper, "The Influence of Work and Annealing on Brass," by Dr. O. F. Hudson. 7 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Children's Lecture, "Old Trades and New Knowledge—the Trade of the Dyer," by Sir W. Bragg. 3 p.m.

WEDNESDAY, JANUARY 6TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Cavendish Café, Cornmarket, Derby. Derby Graduates' meeting. Lantern lecture, "The History of the London General Omnibus Company," by Mr. W. B. Flint. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Students' meeting. Paper, "Recent Improvements in the Works of the Calne Waterworks Company," by Mr. J. Kennard. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "Frequency Variations in Thermionic Generators," by Lieut.-Colonel K. E. Edgeworth. 6 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Pump Circulation," by Mr. J. R. Preston. 7 p.m.

THURSDAY, JANUARY 7TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Institute of Marine Engineers, 85-88, The Minories, Tower Hill, London, E. 1. Paper, "The Fatigue of Metals: A General Survey and an Account of Some Recent Work," by Mr. H. J. Gough and Dr. D. Hanson. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Lecture, "The Past, Present, and Future Development of Wireless Telephony," by Captain P. P. Eckersley. 6 p.m.

INSTITUTION OF SANITARY ENGINEERS.—Caxton Hall, Westminster, London, S.W. 1. Presidential Address by Mr. Edward Willis. 7.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—7, Albemarle-street, London, W. 1. Paper, "The Experimental Analysis of Frameworks, with Special Reference to the Problems of Airship Design," by Professor A. J. Sutton Pippard. 6.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Children's Lecture, "Old Trades and New Knowledge—the Trade of the Potter," by Sir W. Bragg. 3 p.m.

FRIDAY, JANUARY 8TH.

CHEMICAL ENGINEERING GROUP.—Chemical Society's Rooms, Burlington House, Piccadilly, London, W. 1. Papers, "The Manufacture of Hydrogen Suitable for the Hydrogenation of Oils," by Mr. A. E. Knowles; "The Production of Hydrogen by Micro-organisms," by Dr. A. C. Thaysen. 8 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Third Report of the Marine Oil Engine Trials Committee. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Notes on Salesmanship," by Mr. A. J. Simpson. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne. "Star Contra Propeller," by Mr. Walter Pollock. 7.30 p.m.

SOCIETY OF TECHNICAL ENGINEERS.—Queen's Hotel, Birmingham. Paper, "The Research Factor in Cable Making," by Captain P. Dunsheath. 7.30 p.m.

SATURDAY, JANUARY 9TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the Peckham Rye Repair Shops, Southern Railway, Brighton Electric Services.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Lecture, "Old Trades and New Knowledge—the Trade of the Miner," by Sir William Bragg. 3 p.m.

MONDAY, JANUARY 11TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Paper, "The Mechanical Properties of Non-ferrous Metals and Alloys at High Temperatures," by Professor F. C. Thompson. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. London Graduates' cinema evening. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper, "The Elimination of Noise in the Motor Cycle," by Mr. H. Briggs. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—University College, Gower-street, London, W.C. 1. Informal meeting. Discussion on "The Electrical Installation at the Rockefeller Building, University College," opened by Mr. W. C. Clinton. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND STUDENTS' SECTION.—Temperance Hall, Temple-street, Birmingham. Exhibition of films. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. "The Reduction of Factory Costs," by Mr. E. H. Lewis. 7 p.m.

TUESDAY, JANUARY 12TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "Logic Applied to Failures," by Mr. J. D. Parkes. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "High-level Bridge, Newcastle-upon-Tyne: Underpinning and Repair of Foundations of River Piers," by Mr. C. F. Bengough. 6 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "Failure of Metals by Creep," by Professor W. Kerr. 7.30 p.m.

POPLAR SCHOOL OF ENGINEERING OLD BOYS' SOCIETY.—High-street, Poplar, London, E. 14. Paper, "The Tower Bridge, its History, Construction and Erection," by Mr. N. S. Williams. 7.45 p.m.

WEDNESDAY, JANUARY 13TH.

INSTITUTION OF CHEMICAL ENGINEERS.—Chemical Society's Hall, Burlington House, Piccadilly, London, W. 1. Papers: "A Critical Review of Published Experiments in Filtration," by Mr. A. J. V. Underwood; "Tube Mill Grinding—with Special Reference to Grinding in a Current of Air," by Dr. G. Martin. 8 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Informal meeting. Discussion on "The Testing and Examination of Materials for Railway Construction," introduced by Mr. F. J. Paice. 6 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE.—St. Bride Institute, Bride-lane, Fleet-street, London, E.C. 4. Paper, "Industrial Economics," by Mr. J. W. L. Rowe. 8 p.m.

THURSDAY, JANUARY 14TH.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—9, The Temple, Dale-street, Liverpool. Third Report of the Marine Engine Trials Committee, presented by Mr. Sterry B. Freeman. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the Tobacco Factory of Carreras, Ltd., City-road, London, E.C. 1. 1.45 p.m.

FRIDAY, JANUARY 15TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Non-ferrous Section, Applied Science Department, the University, Sheffield. Paper, "The Early History of Gold," by Professor C. H. Desch. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Paper, "The Wire-drawing Process," by Professor F. C. Thompson. 7.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Novelties at the 1925 Engineering Exhibitions." 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "The Commercial Side of Foundry Work," by Mr. J. Wolstenholme. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Albert-square, Manchester. Paper, "The Value of Research in the Production of Castings," by Mr. J. G. Pearce. 7.15 p.m.

TUESDAY, JANUARY 19TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-upon-Tyne. Paper, "The Principles which Govern the Heat Treatment of Non-ferrous Alloys," by Professor F. C. Thompson. 7.30 p.m.

THURSDAY, JANUARY 21ST.

INSTITUTION OF MECHANICAL ENGINEERS: NORTH-WESTERN BRANCH.—The Engineers' Club, Manchester. Annual meeting. Paper, "Piston Temperatures and Heat Flow in High-speed Petrol Engines," by Professor A. H. Gibson. 7 p.m.

FRIDAY, JANUARY 22ND.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Piston Temperatures and Heat Flow in High-speed Petrol Engines," by Professor A. H. Gibson. 6 p.m.